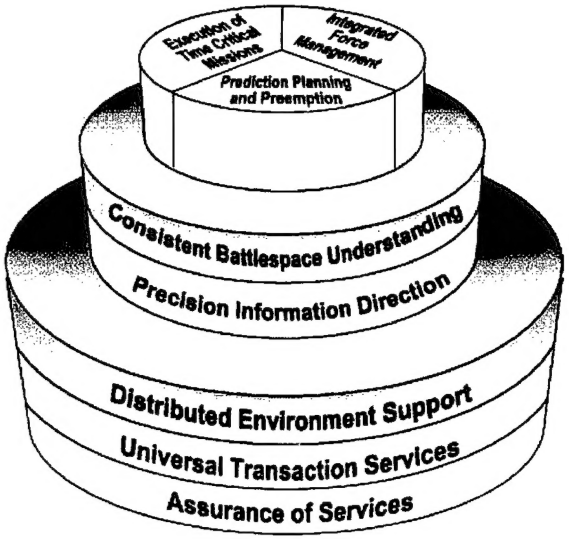

Advanced Battlespace Information System (ABIS) Task Force Report

Volume III

Battle Management Working Group Results

Director of Command, Control, Communications, and Computers (Joint Staff)

Director, Defense Research and Engineering (OSD)

May 1996

Advanced Battlespace Information System (ABIS)

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Battle Management Working Group Results

May 1996

Co-Chairmen:
Mr. Don Eddington, NCCOSC
Col Ron Fly, Joint Staff/J38

Preface

This is Volume III of the final report of the Advanced Battlespace Information Systems (ABIS) Task Force. The entire final report is organized into six separately bound volumes:

I. Executive Summary

II. Major Results

III. Battle Management Working Group Report

IV. Sensor-to-Shooter Working Group Report

V. Grid Capabilities Working Group Report

VI. Supporting Annexes

This volume is the full report of the Battle Management Working Group. It contains an executive summary of the major findings and conclusions and a detailed discussion of the specific areas that were considered by the working group.

Table of Contents

1. Executive Summary

Definition and Scope

Battle Management includes operations planning, force management and coordination, and direction of C3ISR during mission execution. It spans current operations through future operations to future plans, with the corresponding situation/crisis assessment and operational evaluation at each level. Battle management deals with multiple decision loops including a fast, sensor-to-shooter decision loop that is dealt with separately by the Sensor-to-Shooter Working Group. It also deals with complex issues like the uncertainty of large amounts of information and aggregation of many variables into the assessment of progress in achieving a given objective.

Scope:

- *Reviewing, Refining, and Expanding the System-of-Systems Concept*
- *Developing and Refining Revolutionary Capabilities Objectives*
- *Constructing a Roadmap of Relevant Technologies and Demonstrations*
- *Supporting the Secretariat in Developing the Overall Integrated System-of-Systems Construct*

Definition and Scope

Battle management encompasses operations planning, force management and coordination, and direction of ISR and C3. In the evolving joint force staff structure, it spans current operations through future operations to future plans, with the corresponding situation/crisis assessment and operational evaluation at each level. Battle management deals with multiple decision loops including a fast, sensor-to-shooter decision loop that is dealt with separately by the sensor-to-shooter working group. It also deals with complex issues like the uncertainty of large amounts of information and aggregation of many variables into the assessment of progress in achieving the desired end state of a battle or campaign.

The Battle Management Working Group addressed operational and C2I concepts in the context of Major Regional Contingencies (MRC), Lesser Regional Contingencies (LRC), or during the transitional (e.g., Early Entry) phases of the MRC when the United States can dominate a much larger force by rapid action, overbearing lethality, high-quality information, and high survivability. This dominance is derived from rapid mobility and dispersion in an "empty battlespace" to minimize large force-on-force throughout the conflict spectrum.

The United States Is Fundamentally Changing the Prosecution of War Through IT Dominance

- Exploiting IT Enables New Operational Concepts
  - — Flattened Command Structure: Widespread Dissemination of Information and Understanding
  - — Quicker Decision and Execution; Operate Within and Disrupt Adversary's Decision Cycle
  - — New Operational Capabilities
    - + Consistent Battlespace Understanding
    - + Predictive Planning and Preemption
    - + Incremental Force Projection
    - + Precision Information Direction
    - + Integrated Force Management
    - + Adaptive Coordinated Defense
- A Quantum Improvement in Operational Performance* Without Quantum Cost Growth
  - — Precision Throughout the Operational Spectrum Is Essential (Sensors, Intelligence, Plans, Execution)—PGMs Are Only a Small Part
  - — Focus on the Objective and Leverage Resources
  - — Right Asset—Right Place—Right Time
- New Operational Concepts Focus the Joint Science and Technology (S&T) Program
  - — DTAPs (Defense Technology Area Plans)
  - — DTOs (Defense Technology Objectives)
  - — Seven Significant Technology Investment Areas
  - — Information Fills the Voids

Early and Continuous Interaction Between Warfighters
And Technologists (Battle Labs & Exercises) Must Be Maintained

* VADM Cebrowski's Charge to Working Group in First Off-Site

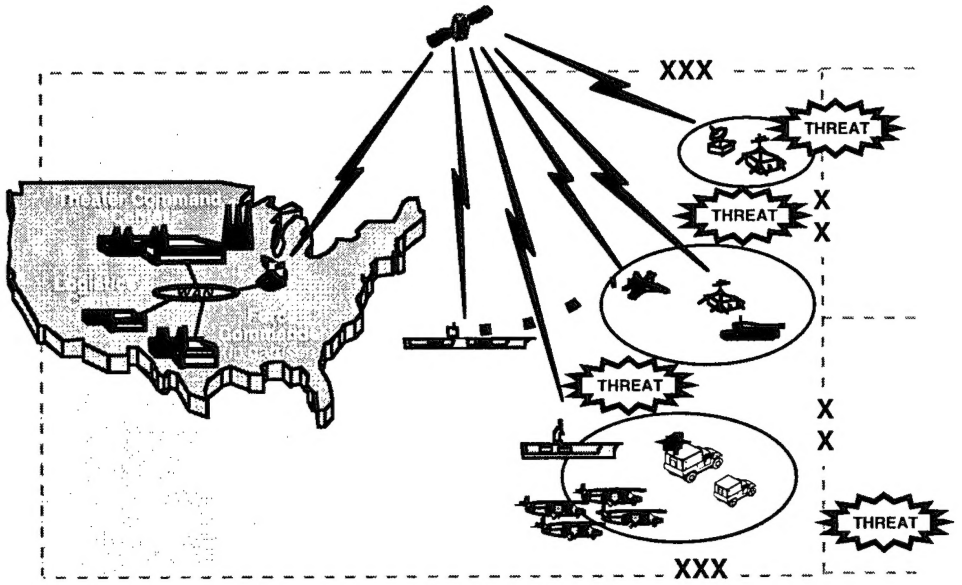
United States Changing the Prosecution of War

To fundamentally change the prosecution of modern wars, the United States is relying on the emerging information technology that will enable us to dominate the battlespace. This figure illustrates the top-level view of the results of the Battle Management Working Group. This effort presumed the presence of grid capabilities and incorporated the idea that the sensor-to-shooter working group efforts are a specialized case of battle management. Another, equally important underlying premise was that battle management would be scenario independent, that is, the techniques might vary, but the principal operational concepts would remain constant at all levels and for both offensive and defensive operations. Effective battle management is, therefore, essentially similar in both phases of combat, albeit with different operational objectives.

The working group began with the assertion that battle management for Vision 2010 required an unconstrained view and that operational concepts necessarily preceded the technology considerations. This approach enabled the warfighter rather than technology to be the focus. The study began with the system-of-systems vision, from which it developed a set of six major new operational concepts that would, if achieved, revolutionize the conduct of warfighting in the next century. These concepts are listed. The goal is to enable the commanders at each respective level to put the right asset at the right place at the right time, thereby enabling them to dominate the battle on their own terms.

Enabling technology was derived by looking first at the concept and its limits, and then determining what operational functional capabilities would overcome the limits. From these analyses, we assessed the technologies that would overcome the limitations.

Battle Management Operational Concept
Force Projection and the "Empty Battlespace"

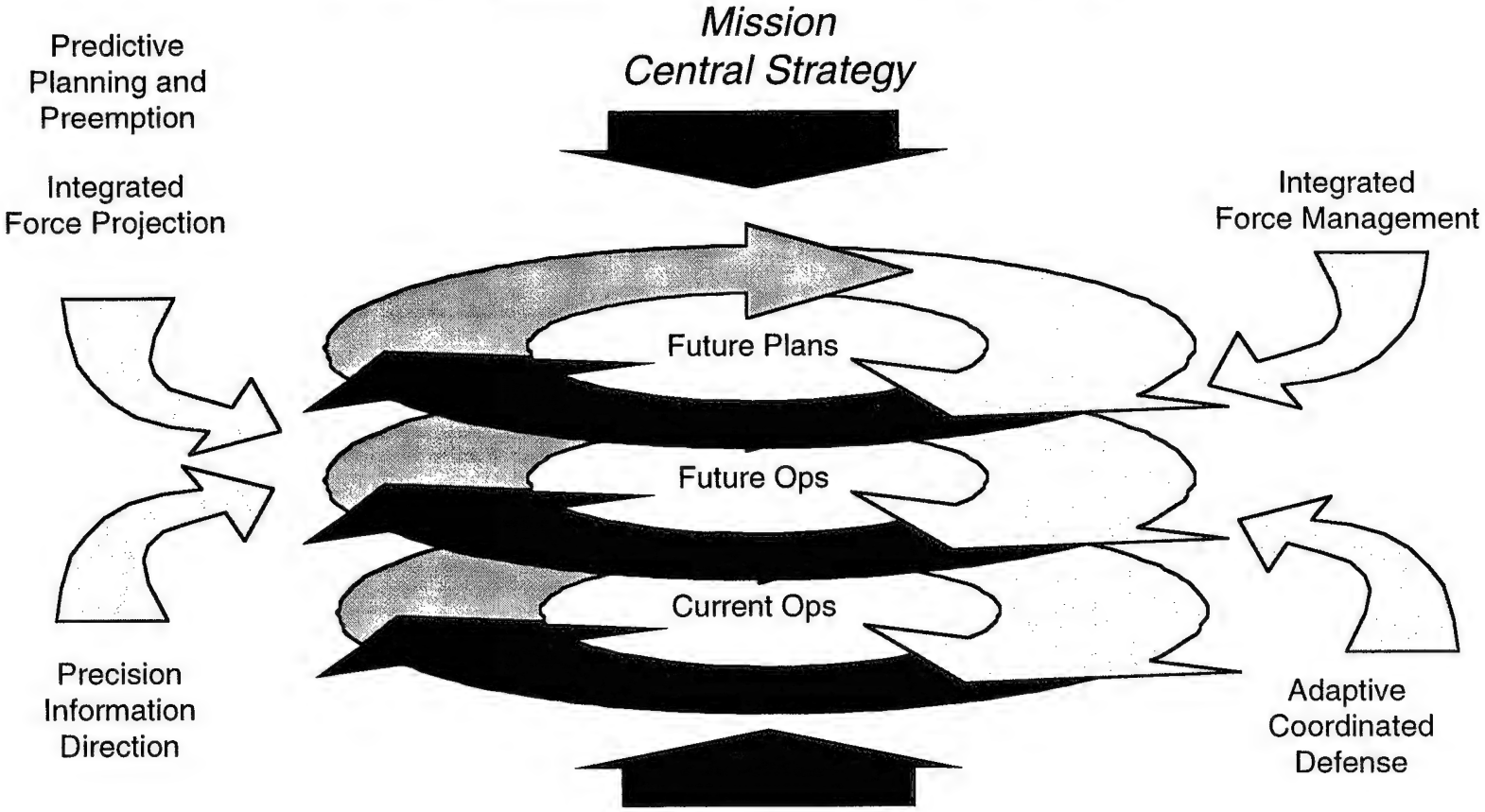


- Force Projection Versus Force Deployment—Reachback, Splitbase, Optimal-Forward Footprint
- Teams and Force Packages Form and Reconstitute As Needed
- Opportunity Planning—Precise Surveillance, Weapons, and Maneuver in the Empty Battlespace to Maintain Superior Posture and Stay Inside the Enemy's Operation Cycle
- Precision Fire Support
- Responsive, Task-Synchronized Support by Rear-Echelon Information Providers
- Intuitive Command—Coordination Because of Common Understanding of Situation, Intent, and Strategy Rather Than Hierarchical Control
- Coherent Control—Dynamic Allocation and Scheduling of Selected Shared Assets and Critical Targets During Synchronized Engagements
- Operational Tempo Unconstrained by C2 or Systems

Battle Management Operational Concept

Operational concepts considered by the working group included the conflicting advantages/ disadvantages of force projection rather than force deployment. To maintain a dominant warfighting posture in such an environment, the smaller U.S. force must be able to tailor and mass activities at the right place and right time, choosing opportunities where sensors, fires, and forces can be brought together for periods of dominant information and integrated action where required. Real-time, shared information and its clear understanding by coordinating forces replace traditional hierarchical controls in most cases and the provision of that information, be it preplanned or reactive. This flattens the command hierarchy, but it permits "intuitive" command style that can be assisted by the automated planning of "opportunities" and countermoves based on dynamic assessment of the adversary and the options to bring forces, time, space, spectrum, and support together within the window of opportunity.

Vision 2010 Battle Management



Consistent Battlespace Understanding

Vision 2010 Battle Management

A primary goal of battle management in the integrated system concept is to achieve synergy between individual systems to achieve a significant improvement in performance. General improvement consists of decreasing the decision timeline (or increasing the enemy's) and increasing the quality of options assessment at any given decision point. Rather than merely looking for ways to accelerate the current process, the Battle Management Working Group developed reengineered processes to take advantage of advanced automated assistance and information access. This figure shows a very top-level example of process reengineering. A more detailed explanation of process changes will be included in the discussion of each important C2I capability. Process changes are, in many cases, enabled by technology (e.g., virtual deployment and collaboration between dispersed forces).

The current battle management process involves sequential planning cycles that are typically 24 to 72 hours. Because of the complexity of the problem space, information acquired or assumed during planning often changes before or during mission execution. ISR and other tasking, such as in intelligence preparation of the battlefield, generally are based on "requests" for information, which in turn are based on assumptions of conditions during the operation being planned. In many cases, the warfighter may not even have visibility into the status of his request. In the reengineered process, a set of core processes ensures visibility, prioritization, and deconfliction of requests on a highly dynamic and interactive basis that crosses between current ops, future ops, and future plans. Planning, sensor management, and operations execution are driven by total visibility into ongoing activities, planned activities, potential activities, and their relation to the commander's strategy and constraints imposed by other planners. Using "command by prompting," conflicts are elevated to higher decision makers for arbitration only when a conflict is detected. The important C2I capabilities, shown in the reengineered process, are distributed across the forces in a way that interacts seamlessly across missions, echelons, and services.

Important Operational Capabilities

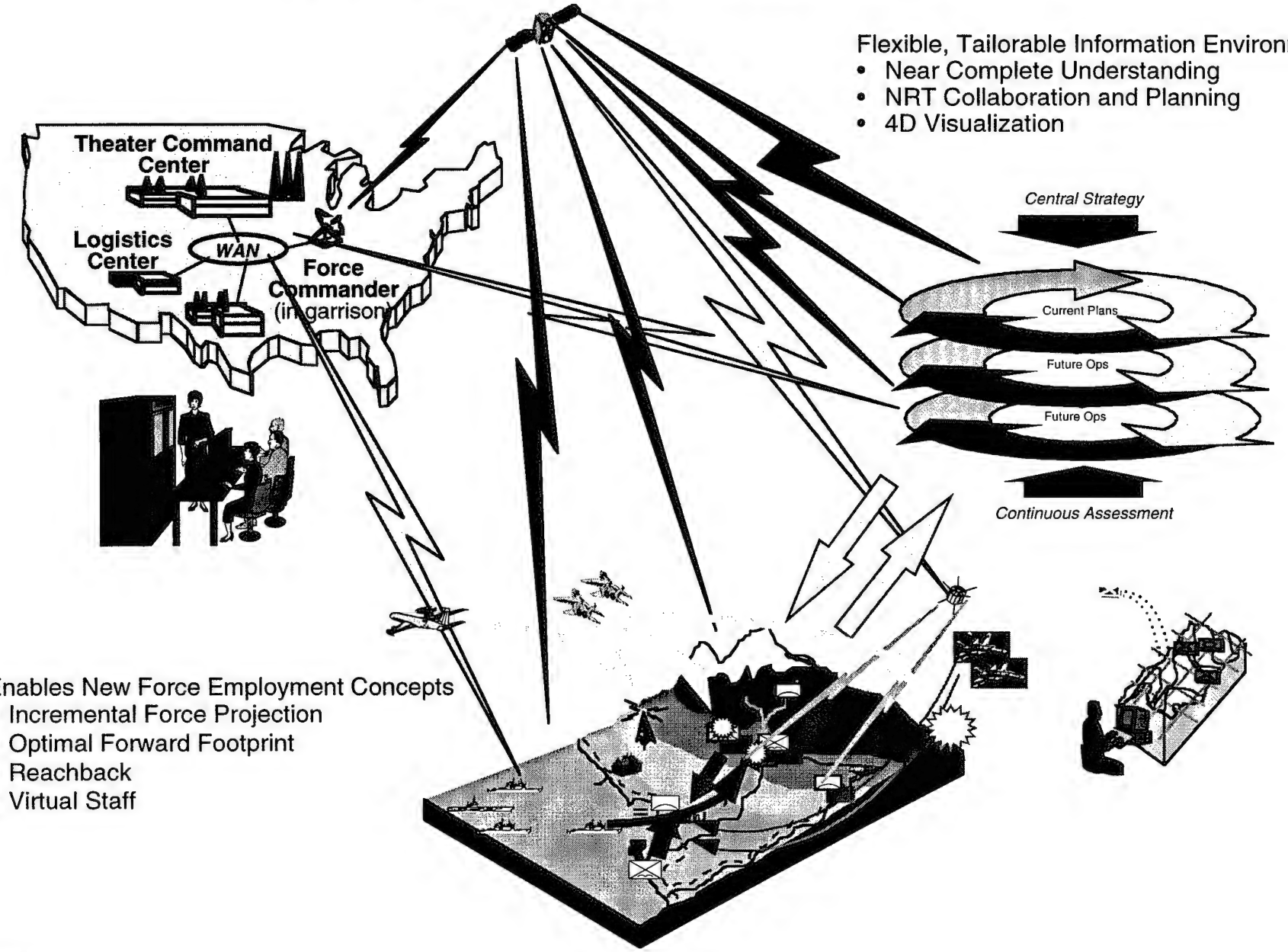
- **Consistent Battlespace Understanding**
  - — Elevate the Level of Cognitive Understanding of the Enemy, Friendly and Geo-Spatial Situation; and Maintain Consistency in That View Across Tactical and Supporting Forces.

- **Predictive Planning and Preemption**
  - — "Lean Forward" in the Planning Process To Avoid Direct Confrontation (by Employing Alternative Means); Be Prepared To React and Exploit Opportunities When Direct Confrontation Must Occur, and To Shape the Expected Actions To Stay Within the Enemy's Decision Cycle and Keep Him Out of Ours.
  - — **Incremental Force Projection**
    - » Be Prepared To Fight From Any State of In-Theater Joint Force Projection, Using Flexible Combinations of Tailored Early-Entry Force Packages, Tactical Force Reconstitution, Global Reach Accelerated Deployment, Virtual Deployment, and Reachback

- **Precision Information Direction**
  - — Enable the On-Scene Commander To Exploit and Shape the Battlespace by Dynamically Directing and Integrating (in Accordance With Operation, Battle and Mission Priorities) Tactical and Supporting ISR Resources for Targeting, Weaponeering, Mission Preview, BDA and Combat Assessment (To Facilitate the Application of Precision Weapons, Precision Forces, and Rapid Response)

- **Integrated Force Management**
  - — Dynamically Synchronize Force Operations by Collaborative Execution Monitoring, Repair, and Retasking of Shared Assets Across Echelons, Missions, Components, and Coalition Forces (Control of "Coherent" Joint/Simultaneous Operations To Optimize Dynamic Use of Resources Without Preempting "Initiative")
  - — **Adaptive, Coordinated Defense**
    - » Integrate Defensive Systems Across Services Into a Collaborative Capability That Exploits Realtime Retasking To Optimize Resources and Coverage and Takes Advantage of Distributed "Empowerment"

Battle Management System Attributes



Battle Management System Attributes

The system attributes for battle management were defined as a set of distributed warfighting forces, command staffs, and support activities that can exist anywhere. In the best circumstances, minimal combat-essential forces would be deployed in a dispersed manner in the operational area, with the remaining support forces in safe enclaves (airborne, offshore, rear-echelon, or CONUS) at distances that depend on their required-on-scene presence at critical times. Dependency on a long-communications tether creates a critical vulnerability (loss of communications), and alternate means of command must be available (e.g., prepositioning of information, plans, and contingency doctrine during periods of good communications). In cases where we cannot supply the required information, we need mass to achieve adequate combat power, enabled through rapid force projection.

The "architecture" for the battle management system assumes a shared, dynamic, consistent information base supported by grid capabilities. Forces would access a network of distributed, interacting servers to implement battle management coordination. Key among these services is the shared understanding of the battlespace and of own and enemy options supporting the continuous RT planning process. As shown, distributed processes generate, access, and utilize this information for synchronizing joint plans and operations. In general, there are processes for planning ISR direction and theater/force-level mission execution, but they are all connected to the central, dynamic representation of operations strategy distributed via the grid.

Technology Demonstration Roadmap—Situation Assessment

Consistent Battlespace Understanding

Precision Information Direction

Knowledge-Based Information Presentation

- Collaborative MC&G and Environment
- Fused Red Picture
- Fused Blue Picture With Force Status, Capabilities, Uncertainty
- Situation/COA Projection (Blue, Red, Environment, Political)

Cognitive Mission Support to the Warfighter

- Tailored Visualization and Knowledge-Based Presentation at Varying Levels of Aggregation
- Common Representation for Battlespace "Understanding"
- Collaboration and Dissemination of Understanding to All Warfighters

End-to-End, Task-Synchronized Mission Support Products to the Warfighter

- Dynamic, Distributed, Joint Target/BDA Strategy
- Distributed Auto Aids (ATR, Target Assessment, Weaponeering, BDA/Combat Assessment)
- Virtually Deploy Analysts
- ISR Responsiveness and Awareness at Tactical Level
- Direct Dissemination
- Mission Materials Visibility

JTF Battlespace Awareness and Visualization Capability

By 2000 Consistent, Accurate, Timely, Comprehensive Battlespace Picture With Quality/Uncertainty Representation (Red/Blue, 2D/3D, Selectable Resolution) Collaborative Situation Assessment and MC&G	Consistent, Accurate, Timely, Mission-Tailored Picture (Current Ops, Future Ops, Future Plans, Log, and the Like)	Consistent, Accurate, Timely, Comprehensive Battlespace Picture (Links From Mission/Tasks to Information Requirements for Distributed Multimedia ISR Management [C2, Intelligence, Weather])
By 2005 Intelligent Agents for Information Retrieval Filtering, Deconfliction, Situation Inference, Pattern Recognition, I&W	Intelligent Agents for Mission/Task-Tailored Portrayal Based on Commander's Intent, Situation Recognition, and Mission Execution Status. Plan Reasoning With Intelligent MC&G	ISR Responsiveness to Real-Time Retasking Autoprepositioning and "Just-in-Time" Delivery of Mission Support Materials (e.g., Target Folders) IAW Predictive Planning Intelligent Agents to Slave ISR to Force Tasks
By 2010 Automated Analysis and Forecasting of Information (Including Red/Blue Projection)	Intelligent Agents for Consistency Management in Dissemination and Recovery Using Advanced Compression and Sanitization	Auto Analysis and Forecasting of Information (Including BDA, ATR, Target Assessment, Weaponeering)

* Draft FY96-02 DTAPS

Technology Demonstration Roadmap—Situation Assessment

Consistent battlespace understanding, when combined with precision information direction, enables the warfighter to have common understanding to support collaborative planning and operations well within the adversary's timeline. Moreover, it enables the warfighter to focus on the enemy while concurrently sharpening his view of his own forces (improved Blue knowledge). Technology Assessment includes two key battle management components—consistent battlespace understanding and precision information direction.

Technology Demonstration Roadmap– Forecasting, Planning, and Resource Allocation

Theater Joint Information and Spectrum Dominance
- Ability to Monitor Information and Frequency Space
- Predictive Control of IW/ C2W Options
- Real-Time Cross-Cueing Between Offense, Defense, IW

Distributed Battlespace Opportunity Planning
- Continuous, Collaboration, Crisis Assessment, Target Selection, and Plan Generation
- Collaborative Plan Refinement, Deconfliction, and Evaluation
- Precision Attrition Planning and Evaluation

Management of Dynamic Force Configurations
- Virtually Deployed Teams
- Employment of Enroute And "In-Reach" Forces
- Robust Planning for Reconstituted Teams

Adaptive Force Package Tailoring, Reconstitution, and Force-Flow Management From the Tactical Level
- High-Resolution Tactical Force Package Tailoring
- Reduction of Force Movement and Supply Backlog During Reconstitution

Advanced Joint Predictive Planning Capability

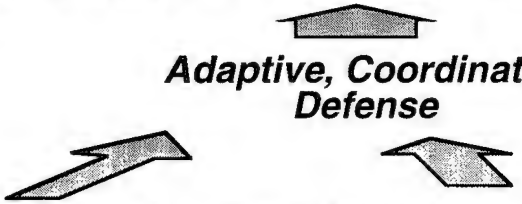
By 2000		
Integrated Joint Force Spectrum Monitoring C2W/IW Effects Prediction	Strategy-to-Task Planning Across Force Continuous, Distributed Replanning, Plan Repair and Variable Fidelity Plan Simulation Across Spectrum of Battle Considerations Interaction Between Current and Future Ops	Full Integration of Staffed and Automated Anchor Desks to Support Reachback and Split-Base Operations End-to-End Rapid Deployment Planning for Adaptive Joint Force Packages
By 2005		
Advanced C2W/IW Techniques; Opportunity Planning for C2W/IW Options Distribute Agents for Spectrum Deconfliction	Autocritical Node Analysis and "Empty Battlespace" Opportunity Recognition Autoplan/Counterplan Generation Intelligent Agents for Distributed Plan Deconfliction and Target Selection	High-Resolution Knowledge Bases for Tactical-Level Adaptive Force Tailoring Total Asset Visibility/In-Transit Visibility Integrated Into Tactical Tailoring and Enroute Force Flow Management
By 2010		
C2W/IW BDA Incorporated Into Predictive Planning and Preemption Process	Distributed Opportunity Planning and Complex COA Evaluation Fully Integrated With Integrated Force Management and Precision Information Direction	Dynamic Dispersion, Mission-Reconstitution, Retraining, Rehearsal, and Redeployment

* Draft FY96-02 DTAPS

Forecasting, Planning, and Resource Allocation

Predictive planning and preemption, two other battle management components, combine with incremental force projection to enable more efficient forecasting, planning, and resource allocation.

Technology Demonstration Roadmap–Force Management



Retasking, Rehearsal for Coordinated Ops Enroute and On-the-Move

- Near-Real-Time Dissemination of Coordinated Task Changes
- Coordinated, Multi-Mission, Multiechelon Preview and Rehearsal of Synchronized Operations Engagements

Distributed Empowerment

- Dynamic Tasking Linked to Central Strategy
- Simultaneous Coordinated Operations
- Simultaneous Engagement
- C2W-Resistant, Rapid-Engagement Quality Picture
- Cooperative Tactics, Uncertainty, and Complex Posture Depiction

Intelligent, Cooperative, Joint Force Automated Battle Doctrine

Integrated Offensive/Defensive Doctrine

- Integrated With Synchronized Force Offense Management and Predictive Preemption
- Cooperative, Intelligent ROEs
- Integrated Hard/Soft Kill and Avoidance Options (Dispersion, Signature)
- OTH, Cooperative Engagement

JTF Battlespace Awareness and Visualization Capability

By 2000		
Multimission, Multiechelon Dynamic Mission Preview and Rehearsal Integration With Joint Simulation Centers	Visibility of Central Strategy and Intermission/ Interechelon Priorities at All Levels of Dynamic Task Execution	Automated Integration of Defensive Response Into Dynamic Overall Force Task/ Resource Allocation Priorities (Hard Kill/ Soft Kill, Preemption)
By 2005		
Dissemination of Retasking On-the-Fly, And Mission Rehearsal On-the-Move Automated Opposing Force Simulation	Integration of Simultaneous Coordinated Operations and Simultaneous Engagements Intelligent Agent Environment to Support Dynamic Coordination Across Distributed Executing Forces	Intelligent Automated Battle Doctrine for Joint Force Autoresponse and Semi-Auto Response to Quick-Reaction Threats Dynamic Threat Avoidance Coordination
	Synchronization Between Executing Tasks and Precision Information (ISR) Direction	
By 2010		
Continuous Combat Assessment Continuous Reassessment/Preview Of "What-If" Options for Predictive Replanning	Adaptive Interfaces and Autolanguage Translation for Real-Time Mission Cueing Joint Cooperative Engagement Quality Link	Fully Automated Cooperative Doctrine and Engagement Across Services, Integrated With Distributed Empowerment Doctrine "Learning" by Autonomous Systems

* Draft FY96-02 DTAPS

Force Management

Integrated Force Management combines with an Adaptive Coordinated Defense to improve Joint Task Force Battlespace Awareness and Visualization Capability.

Major Challenges

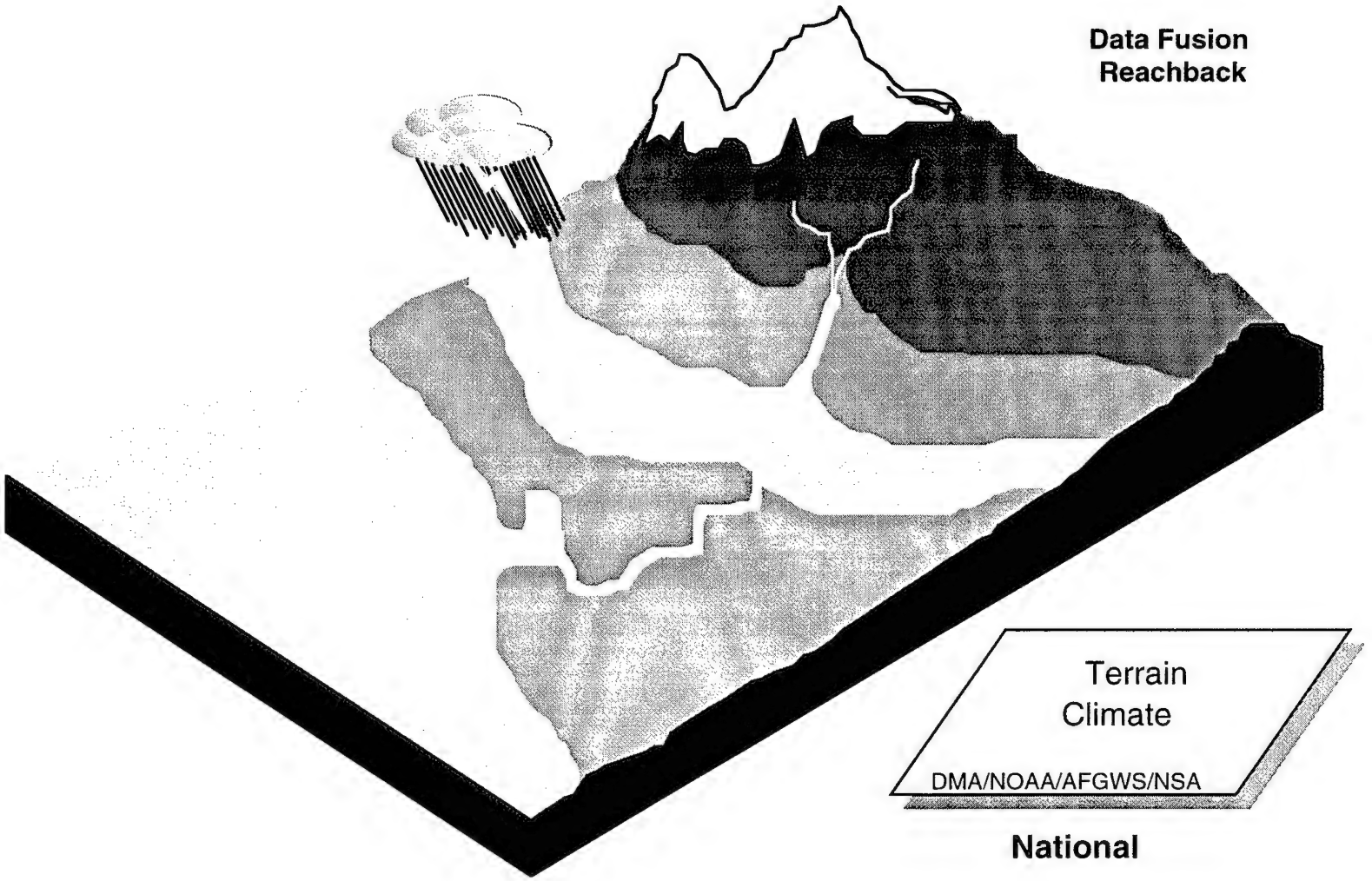
- Continued Warfighter–Technologist Interaction Over Time and Within the Development, Procurement Processes
- Integration of IW, ISR, and How to Better Integrate Information Providers With Operators
- Including Weapons and Sensors in Subsequent Efforts
- Focusing on Concepts at Varying Levels of Command, e.g., the Company Commander Problem Is Different From the Corps Commander or Battle Group Commander's Problem
- Continued Insertion Into Defense Technology Planning Processes and Acquisition Programs

Major Challenges

As indicated in the title, the Battle Management Working Group effort has yielded a definition of remaining challenges. These are cited in the following text and figures.

2. Results

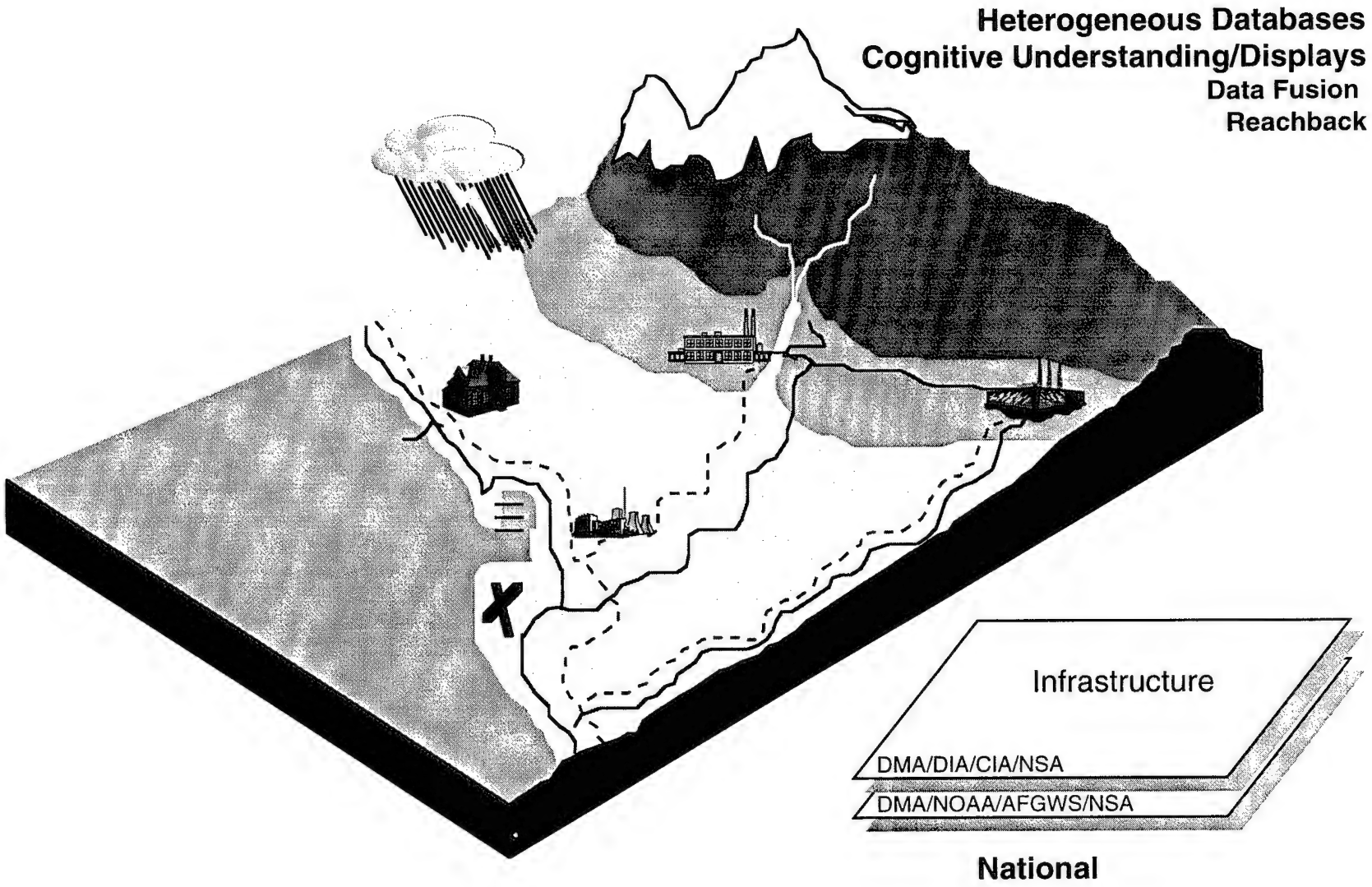
The Battlespace



The Battlespace

We can view the operational and functional relationships of the six important C2I capabilities through the consistent battlespace understanding "window." Each of the capabilities provides distributed functionality that adds layers of information to the common view. The battlespace starts with information on the physical environment, including terrain, climatology, and meteorological/oceanographic (METOC) conditions. A goal in understanding the basic environment is to have intelligent representations on which planning and decision-aiding systems can reason. For wide area operations management, the current products are generally adequate (e.g., 100-meter resolution terrain data and 1,000-meter environmental data), but for precision planning, resolutions of 3 to 10 meters are required. This necessitates the ability to rapidly generate this information on demand (both tactically and nationally), to store the huge files that are produced, and to transmit the appropriate portions of it around the grid.

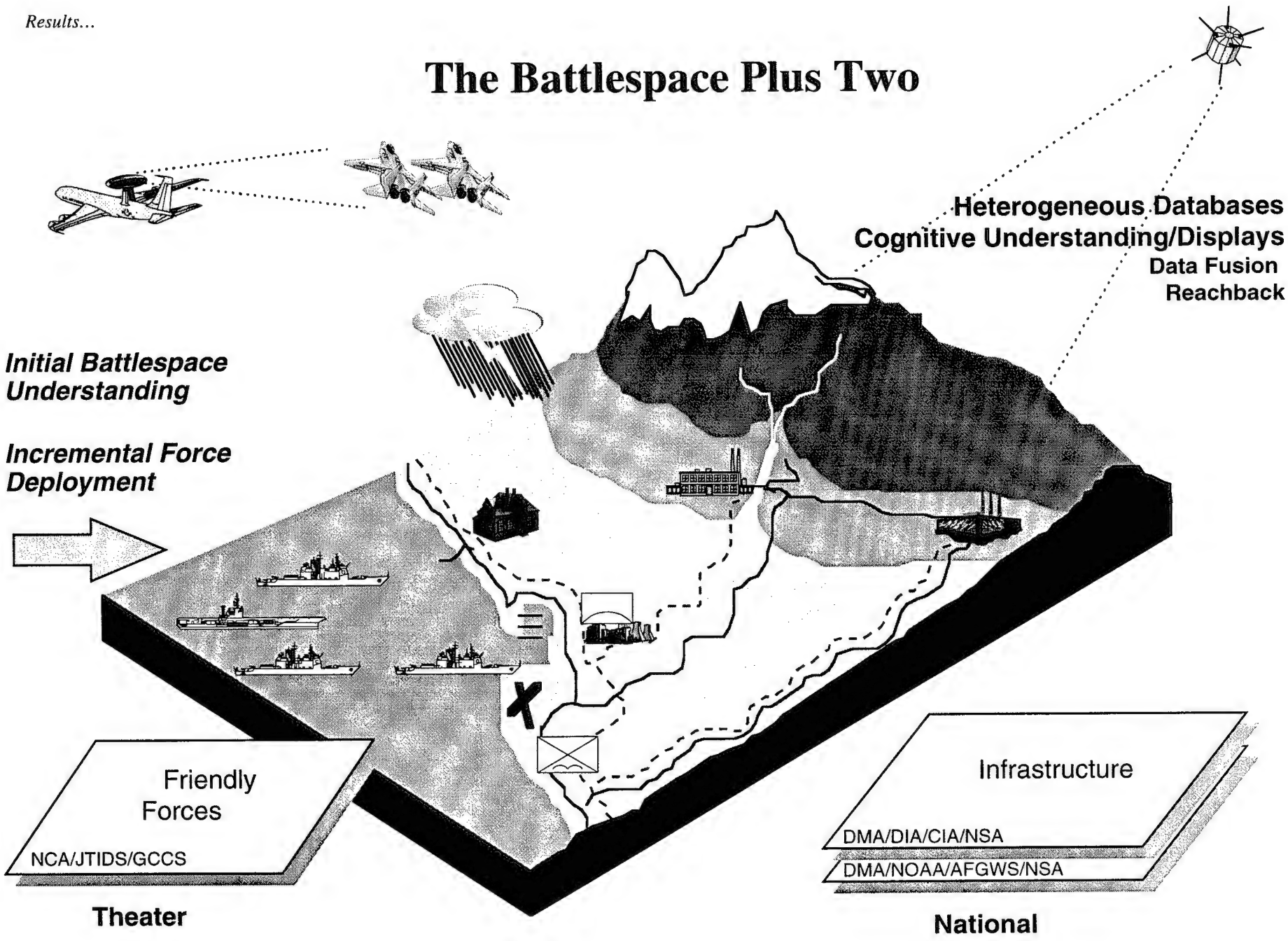
The Battlespace Plus One



The Battlespace Plus One

Moving up one layer in the understanding of the battlespace, the warfighter needs to know about cultural and other feature data, which is provided in part by rear echelon-mapping agencies. Using collaborative capabilities, the goal is to be able to intelligently generate and access the appropriate feature data at the appropriate resolution, to manipulate it in the field, and to modify it or fuse it with commercial and organic tactical sources.

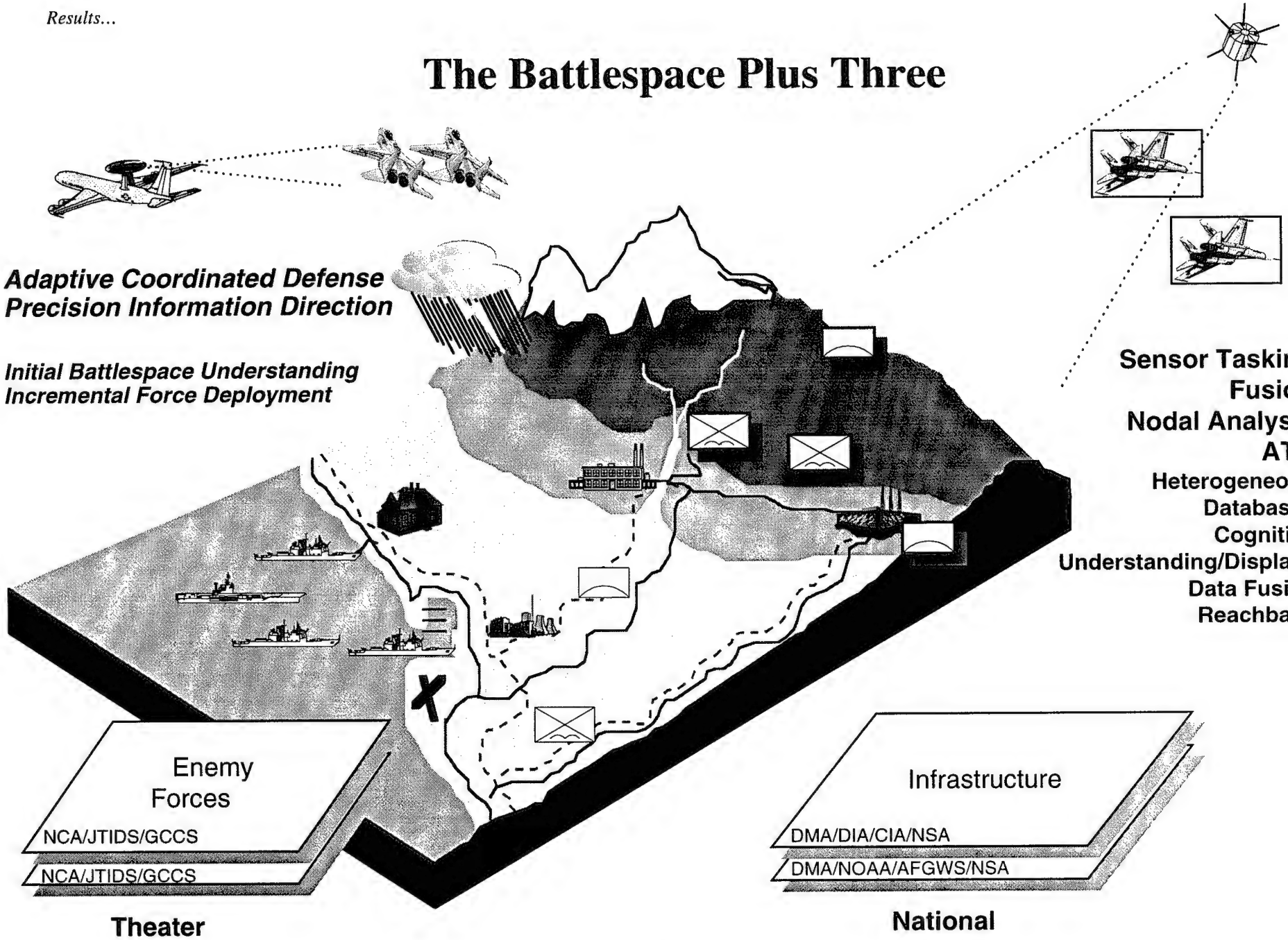
The Battlespace Plus Two



The Battlespace Plus Two

Positioned at two layers up, the battlespace is populated with friendly forces. This not only brings in the currently available "location of forces" information, but adds the requirement to understand what the capabilities, plans, and activities of those forces are. Products of two other important C2I capabilities are added at this point. Incremental force projection brings in the understanding of forces on the way, forces within tactical reach of the operation, and the ability to maintain supply lines and reconstitute those forces for other missions and tasks. Adaptive coordinated defense introduces the capability to understand (and thereby manage) the aggregate, combined defenses of the force to respond to potential threats.

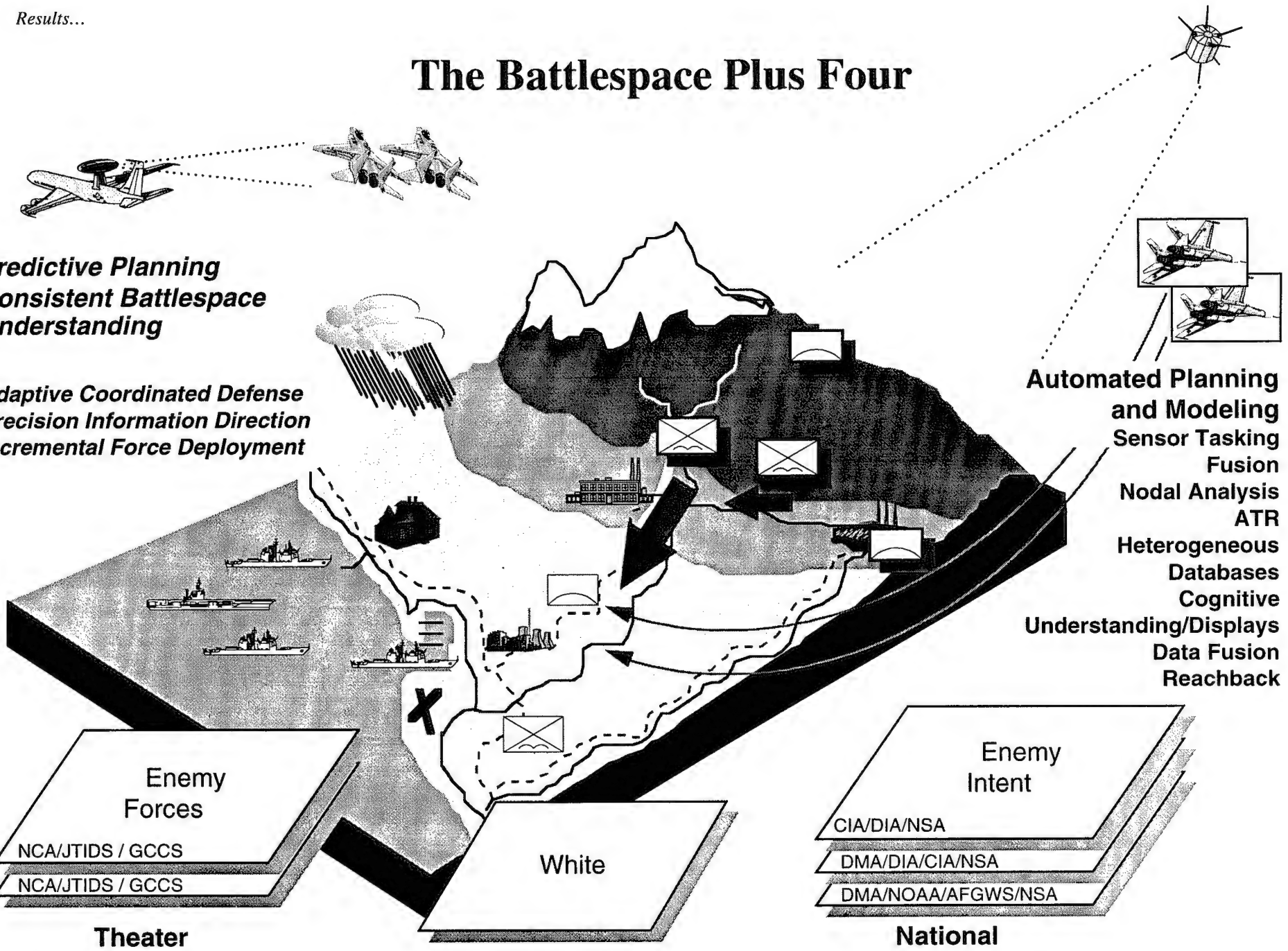
The Battlespace Plus Three



The Battlespace Plus Three

Moving three layers up, battlespace understanding brings in the enemy force picture. It is largely the product of our important C2I capability of precision information direction. Precision information direction is not only the ability to conduct dynamic sensor management between organic and nonorganic sensors, but also the capability to shape the battle into areas where better coverage is possible and to place the control of priorities for dynamic sensor management in the hands of the tactical commander to meet his real-time needs. The term "precision information direction" implies that the tactical commander wants information that is relevant to his tactical operations, without worrying about the peculiarities and internal processes of low-level sensor management. The goal is to direct and schedule, using distributed means, a variety of assets to maintain a near-perfect picture of critical activities (e.g., moving targets) in a relatively small portion of the empty battlespace, during a period of time when friendly or enemy forces will be operating in that area.

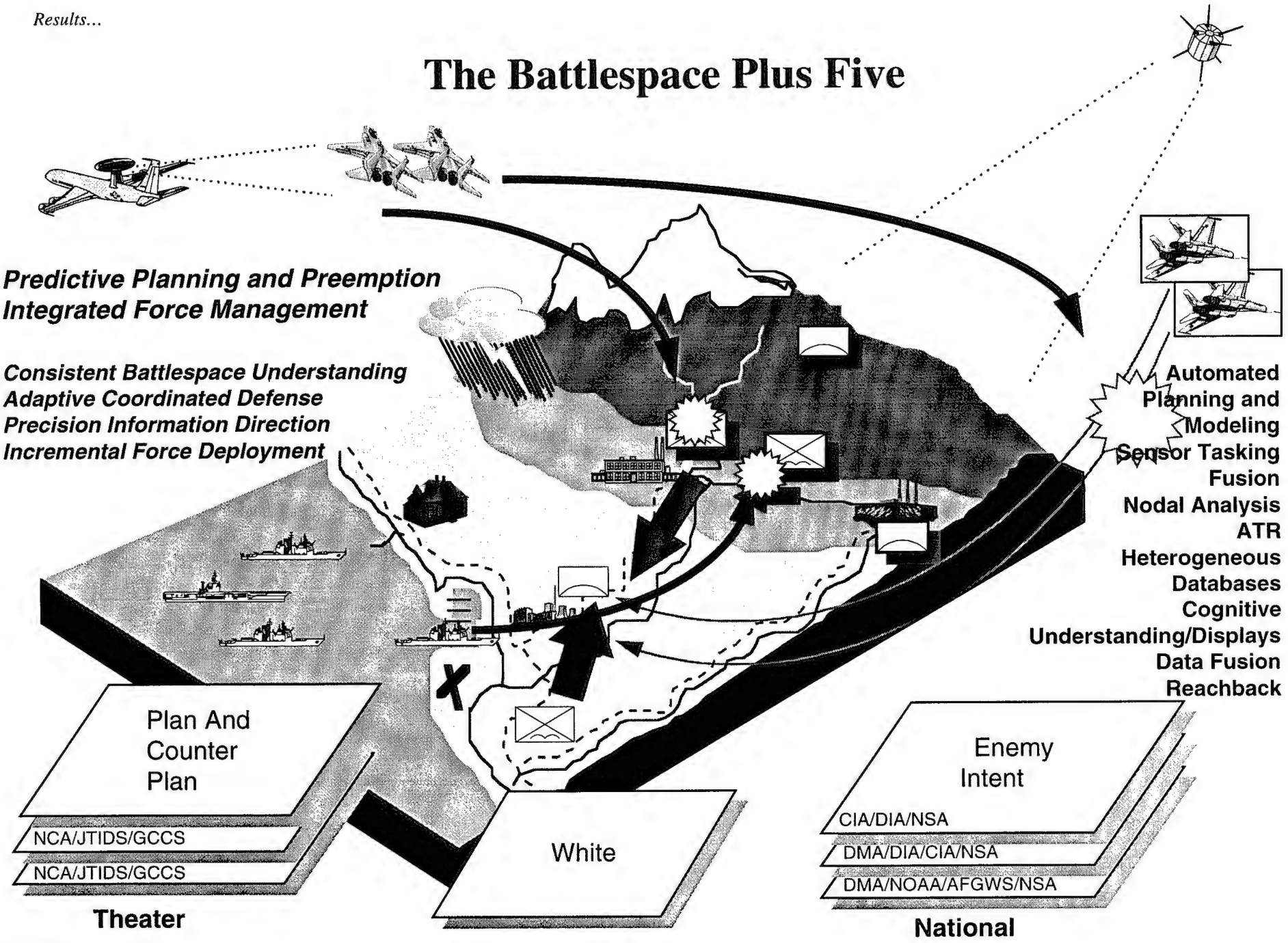
The Battlespace Plus Four



The Battlespace Plus Four

Progressing four layers up, the intelligence (versus surveillance) process brings its value added to bear by projecting possible enemy intentions and options. This process is embedded in the important C2I capability of predictive planning and preemption, which would employ a variety of reasoning and simulation techniques to continuously estimate likely enemy courses of action and assess the critical events and nodes that are either indicators or choke points in those courses of action. From this predictive planning, the system can help the warfighter position his response options for quick execution when a course of action is verified.

The Battlespace Plus Five



The Battlespace Plus Five

The fifth layer up focuses on the anticipatory response by own forces. In the important C2I capability of predictive planning and preemption, options are sought that can avoid major combat confrontation with enemy forces. This involves a sequential set of actions to deceive, discourage, and reduce the number of enemy actions and options as they escalate toward a confrontation. In the important C2I capability of integrated force management, actual combat activities are coordinated in a way that preserves awareness of each task's relationship to the overall commander's strategy and that permits either intuitive, coordinated operations or tightly coupled synchronized engagements depending on the situation and command prerogative. Integrated force management is tied closely with adaptive coordinated defense so that offensive assets can be diverted to critical defensive tasks if the need arises.

Battle Management Operational Concept

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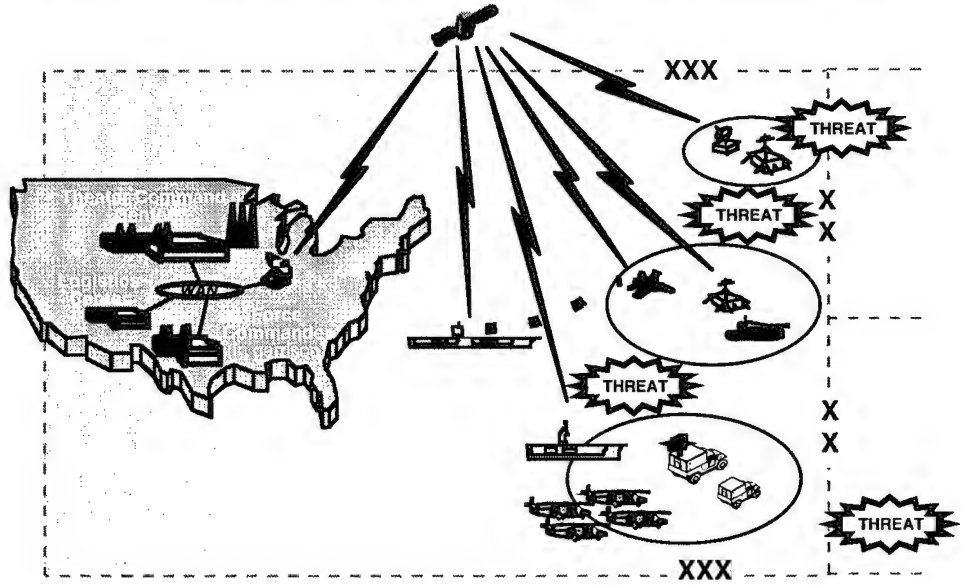

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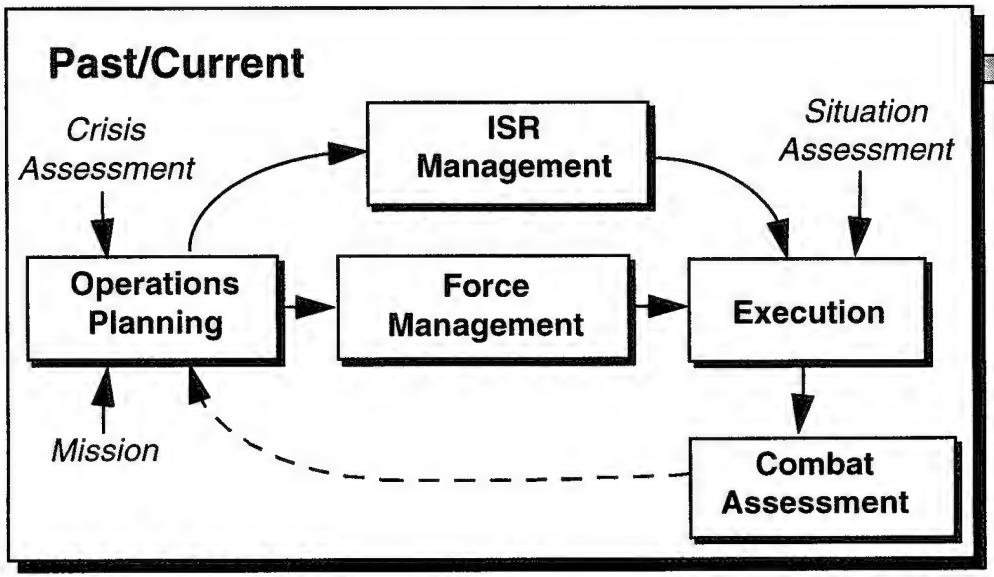
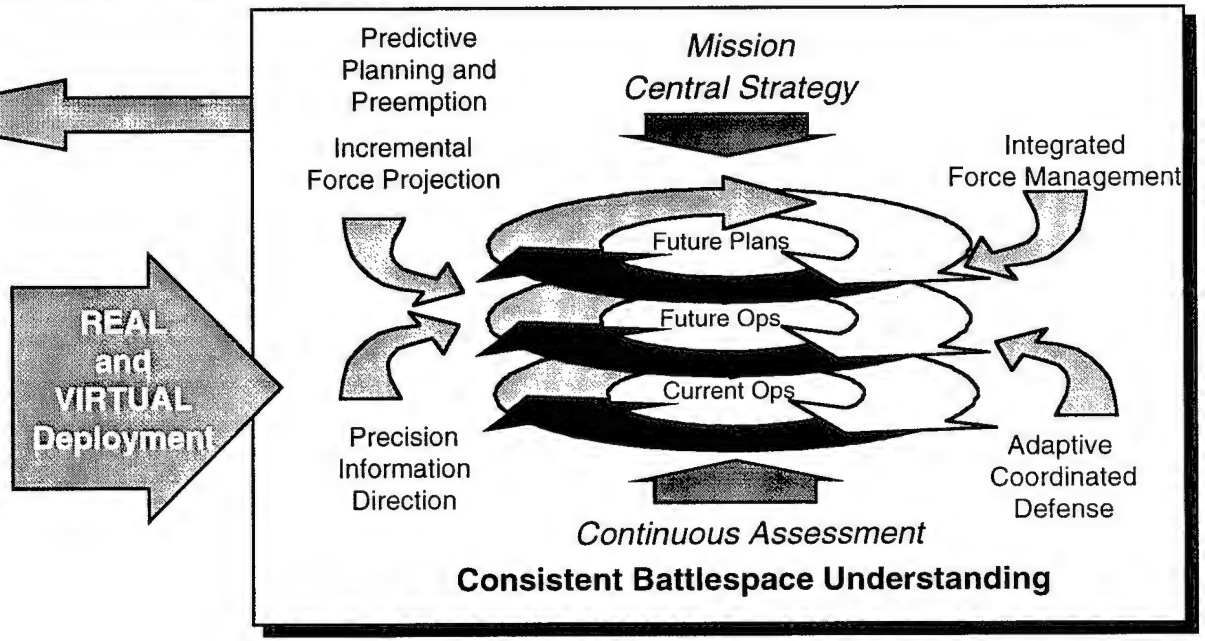


Limitations:
- Sequential, 48- to 72-Hour Cycle
- Little Flexibility
- Missed Opportunities

Payoffs:
- Continuous Replanning and Reconstitution Across Missions, Echelons
- Look-Ahead, Counterplanning
- Synchronized Tasks and ISR to Achieve Desired End State

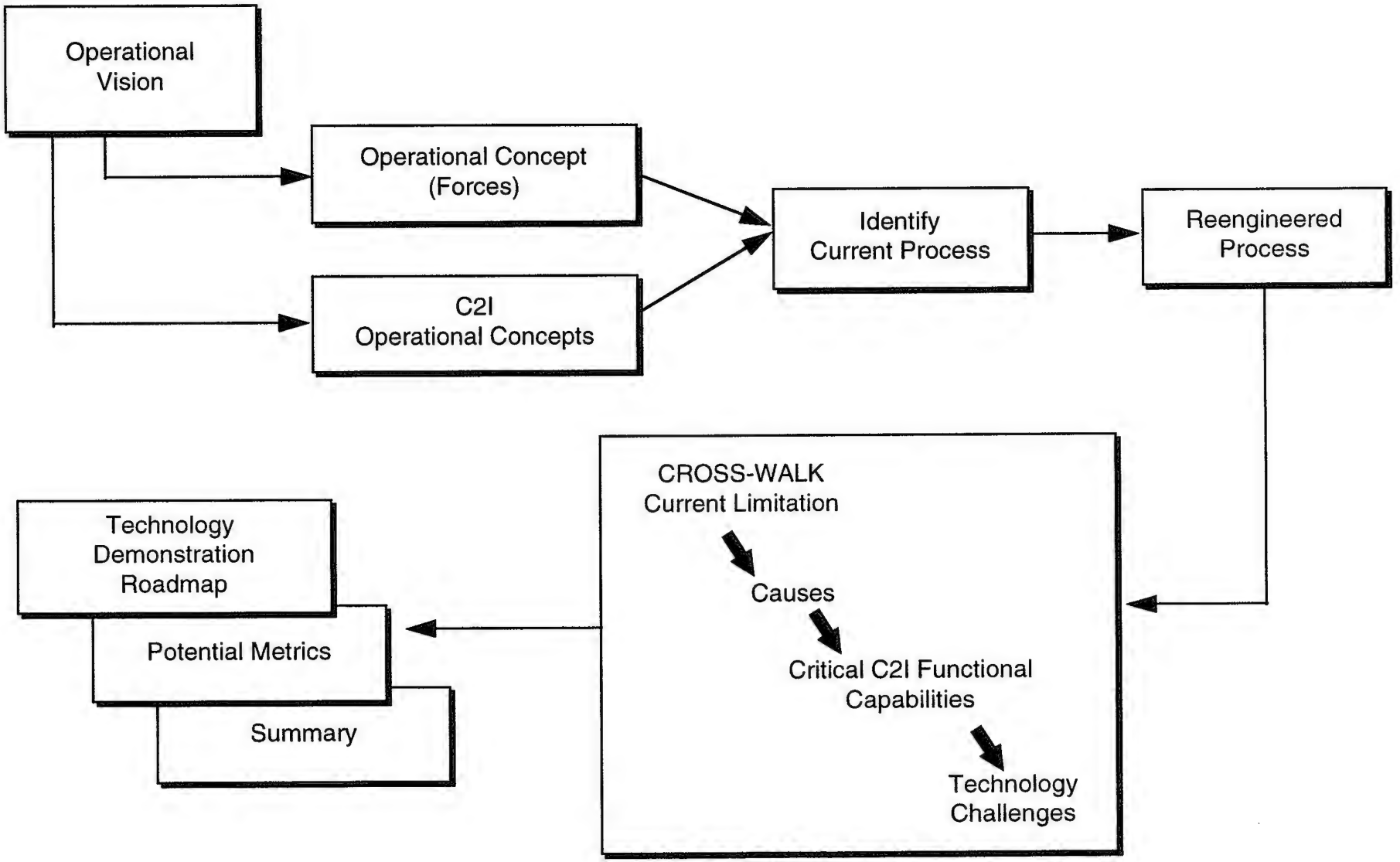


Vision 2010 Reengineered Battle Management Process

A primary goal of battle management in the integrated system concept is to achieve synergy between individual systems to yield a significant improvement in performance. General improvement consists of decreasing the decision timeline (or increasing the enemy's) and increasing the quality of options assessment at any given decision point. Rather than merely looking for ways to accelerate the current process, the Battle Management Working Group developed reengineered processes to maximize advanced automated assistance and information access. This shows a very top-level example of process reengineering. A more detailed explanation of process changes is included in the discussion of each important C2I capability. Process changes are, in many cases, enabled by technology (e.g., virtual deployment and collaboration between dispersed forces).

The current battle management process involves sequential planning cycles, typically 24 to 72 hours. Because of the complexity of the problem space, information acquired or assumed during planning often changes before or during mission execution. ISR and other tasking, such as intelligence preparation of the battlefield, generally are based on requests for information, which in turn are based on assumptions of conditions during the operation being planned. In many cases, the warfighter may not even have visibility into the status of his request. In the reengineered process, a set of core processes ensures visibility, prioritization, and deconfliction of requests on a highly dynamic and interactive basis that crosses between current ops, future ops, and future plans. Planning, sensor management, and operations execution are driven by total visibility into ongoing activities, planned activities, potential activities and their relation to the commander's strategy and constraints imposed by other planners. Using "command by prompting," conflicts are elevated to higher decision makers for arbitration only when a conflict is detected. The important C2I capabilities, shown in the reengineered process, are distributed across the forces in a way that interacts seamlessly across missions, echelons, and services.

Battle Management Group Methodology

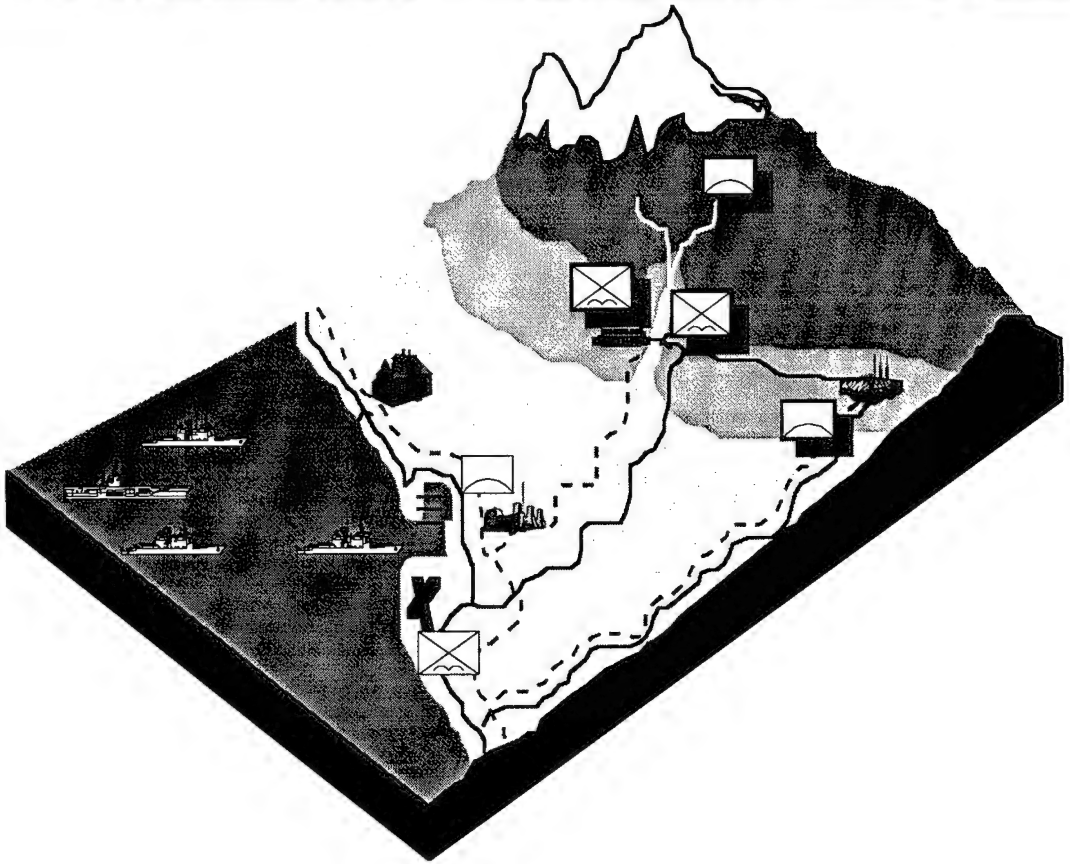


Battle Management Group Methodology

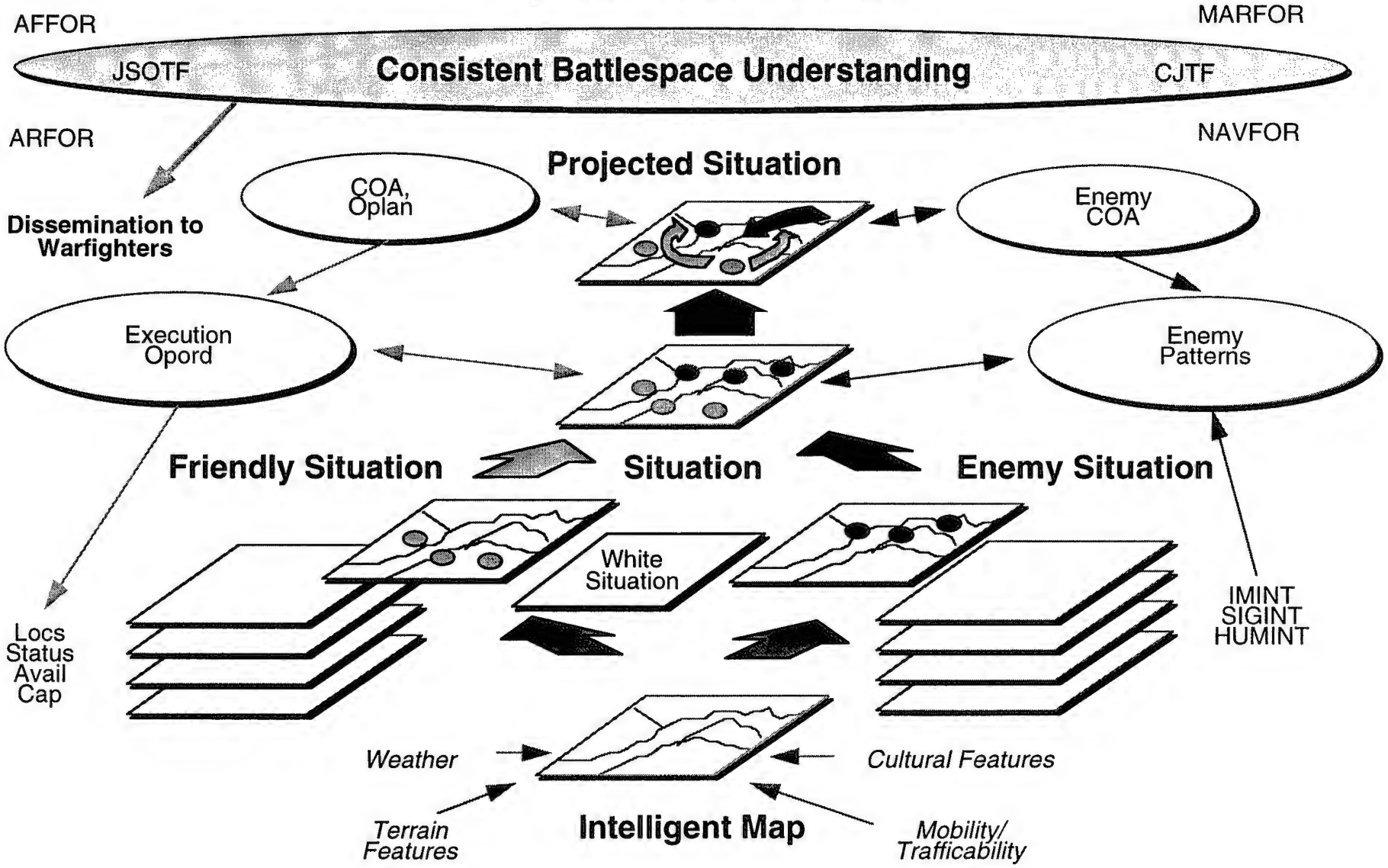
The Battle Management Working Group's methodology undertaken for this study was essentially similar to that of the other working groups. We used the system-of-systems concept as a departure point and developed an operational vision of battle management in the year 2010, as regarding existing doctrine or technology. We refined that in terms of the operational force employment concepts and the necessary C2I operational concepts that would be required to enable the force concept(s). We examined current processes as a baseline and reengineered those processes to develop a picture of how the concepts would work. We performed a cross-walk from the concept in terms of limitations, causes, the critical functions, and then focused on the technology challenges to be overcome. This supported developing the technology roadmap and defining some possible metrics for assessing if a demonstration showed net gain in capability.

Consistent Battlespace Understanding

Goal:
Elevate the Level of Cognitive Understanding of the Enemy, Friendly, and Geospatial Situation, and Maintain Consistency in That View Across Tactical and Supporting Forces



Operational Vision



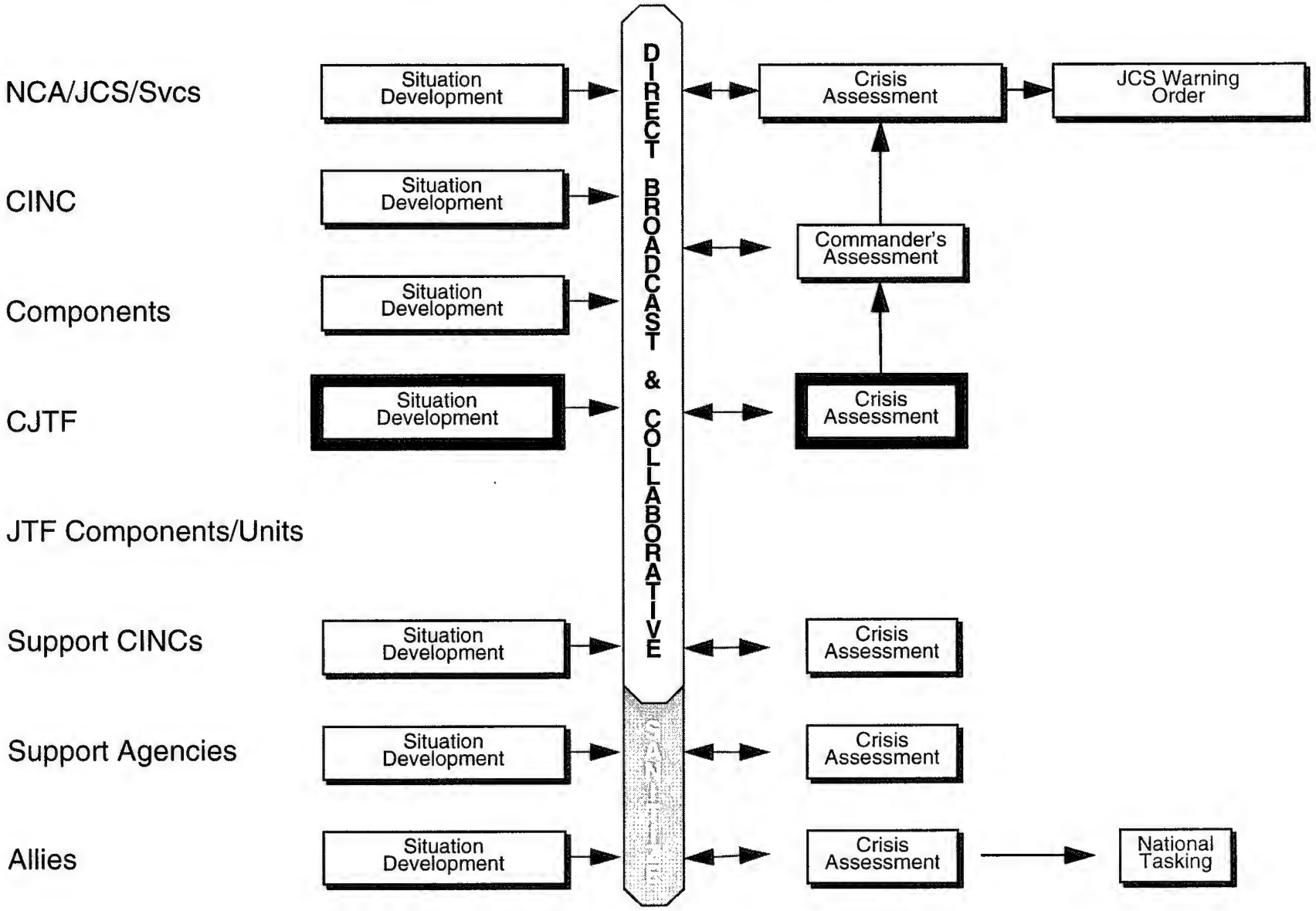
Operational Concepts (Forces)

- Empower Decision Makers by Giving Them Access to Near-Perfect Battlespace Information in Lieu of Traditional Hierarchical Dissemination
  - — Perfect Blue Force ID and Situation Awareness
  - — Autotracking of Equipment and Personnel Assets
  - — Dynamic Plan and Execution Status Awareness
- Shape the Battle Into Areas Where Consistent Understanding Exists and Provide Advantage
  - — Communications and ISR Coverage
  - — Focus ISR to Eliminate Ambiguity
- Over-the-Horizon Engagement
- Splitbase Operations (Reachback) for Intelligence, Personnel, Meteorology and Oceanography, MC&G, Logistics, Financial, Maintenance Information
- Collaborative Situation Assessment

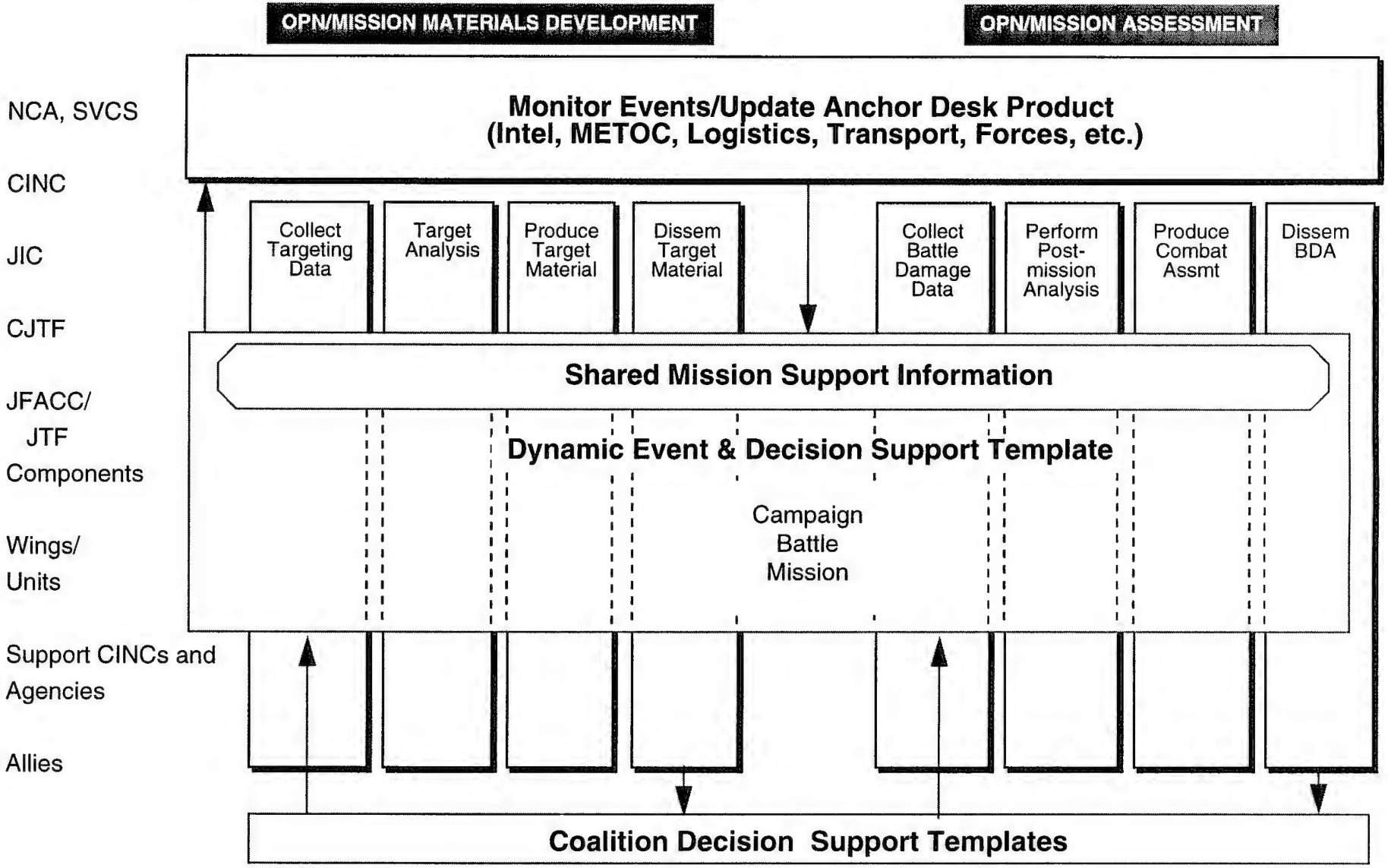
C2I Operational Concepts

- Digitizating of the Battlefield
  - — Situation, Plans, Execution Status
  - — Precise Navigation, Combat ID
- End-User Crafting/Tailored Visualization
  - — Knowledge-Based Information Presentation
  - — Geospatial Information Dominance (MC&G)
- Integrated Sensor Tasking *(Organic Through National)*
- Sensor Cross-Cueing for Improved Battlespace Understanding
  - — Track-From-Base on High-Value Threats
  - — Dynamic, Continuous IPB On-the-Move
- Data, Information, and Knowledge Assurance
- Electronic Preparation and Distribution
  - — Broadcast Dissemination Versus Hierarchical Retransmission
  - — Automated Information Sanitization and Release
  - — Direct Publishing Access
- Visualization of Battlespace Coordination Zones
  - — Joint Engagement Zone Coordination of Fires/Electronic Attack
  - — Joint Airspace Deconfliction With Fires
- Multilevel Security and Sanitization—Varying Degrees of Security With Coalition Force
- Shared Warplan Object and Goals Hierarchy

Reengineered Process



Reengineered Process—Intelligence, MC&G, METOC, Blue



Current Limitations	Causes	Detailed Critical Functional Capabilities	Technology Challenges
Common Operational Picture	Combat ID and Blue Plans Not Well Integrated With Real-Time Picture	Integration of Blue Plans and Status Into Blue Picture	Fusion of Planning Information With Actual Reports
• Blue Knowledge • Blue Plans • Blue Execution Status	Plan Disseminated, Changed Only by Text Message; Execution Status Coordination Only in a Few Areas		Improved Blue Force Pattern and ID Recognition
Situation Projection	No Good Situation Projection Capability	Situation Projection For Own and Enemy COA Estimation	Real-Time Simulation and Projection Algorithms Automated Enemy Force Models Situation Projection in Presence of Uncertain Information Near Real-Time Complex COA Analysis

Current Limitations	Causes	Detailed Critical Functional Capabilities	Technology Challenges
Common Operational Picture (Continued)			
• Physical Transport of MC&G Products	Huge Data Volume	Intelligent MC&G (Geospatial Information Dominance)	Tailored Search, Retrieval, and Pull of MC&G Products
• Uncoordinated Situation Assessment	Slow Updates Turnaround		Intelligent Products To Support Reasoning and Decision Making Systems Collaborative, On-line Mapping From the Field
• Inconsistent Information Across Echelons	Stovepipe and Compartmented Systems	Multisource Fusion/ Sensor Cross-Cueing and Improved Tracking for Red Force Picture	Dissimilar Source Information Normalization Cooperative, Multisource Fusion Algorithms and Cue/ Pattern Recognition Track Movers From Base
Intelligence Preparation of the Battlespace Degrades When Battle Begins	IPB Process Is Manual and Dependent on Static Environment	Collaborative Situation and BDA Assessment Among Intelligent Centers	Common Representation Across Dissimilar Sources and Analysis Processes
	Sensor Tasking		High-Performance Situation Knowledge Bases
	Task Requests Subject to Scheduler's Competing Priorities		Increased Automation of Situation and BDA Analysis

Current Limitations	Causes	Detailed Critical Functional Capabilities	Technology Challenges
Inadequate Information Support to Commander's Decision Needs			
Too Much Information, No Quality Thresholds, Not Scaleable	Inadequate Shared, Dynamic View of Information Needs	Visibility of Mission, Centers of Gravity, Commander's Intent, and Information Requirements to Dynamically Drive Coordinated Operations at All Levels of Detail (Current Operations, Future Operations, Future Plans) Tailored Visualization and Knowledge-Based Presentation of Situation, Plan, and Execution Status at Various Levels of Aggregration	Forcewide "Blackboard" to Coordinate Interdependent Operations and Information Needs Intelligent Information Aggregation, Quality and Relevance Based Multidimensional Information Visualization Tactical Information Display Agents and Inferencing
		Common Representation for Battlespace "Understanding"	High-Performance, High-Resolution Knowledge Bases
Inadequate Dissemination of Understanding	Hierarchical Retransmission, Saturation	Collaboration on and Dissemination of Understanding to All Warfighters	Collaboration, Consistency, Uncertainty Management and Aggregation Via Broadcast Technology

Detailed Critical Functional Capabilities Summary

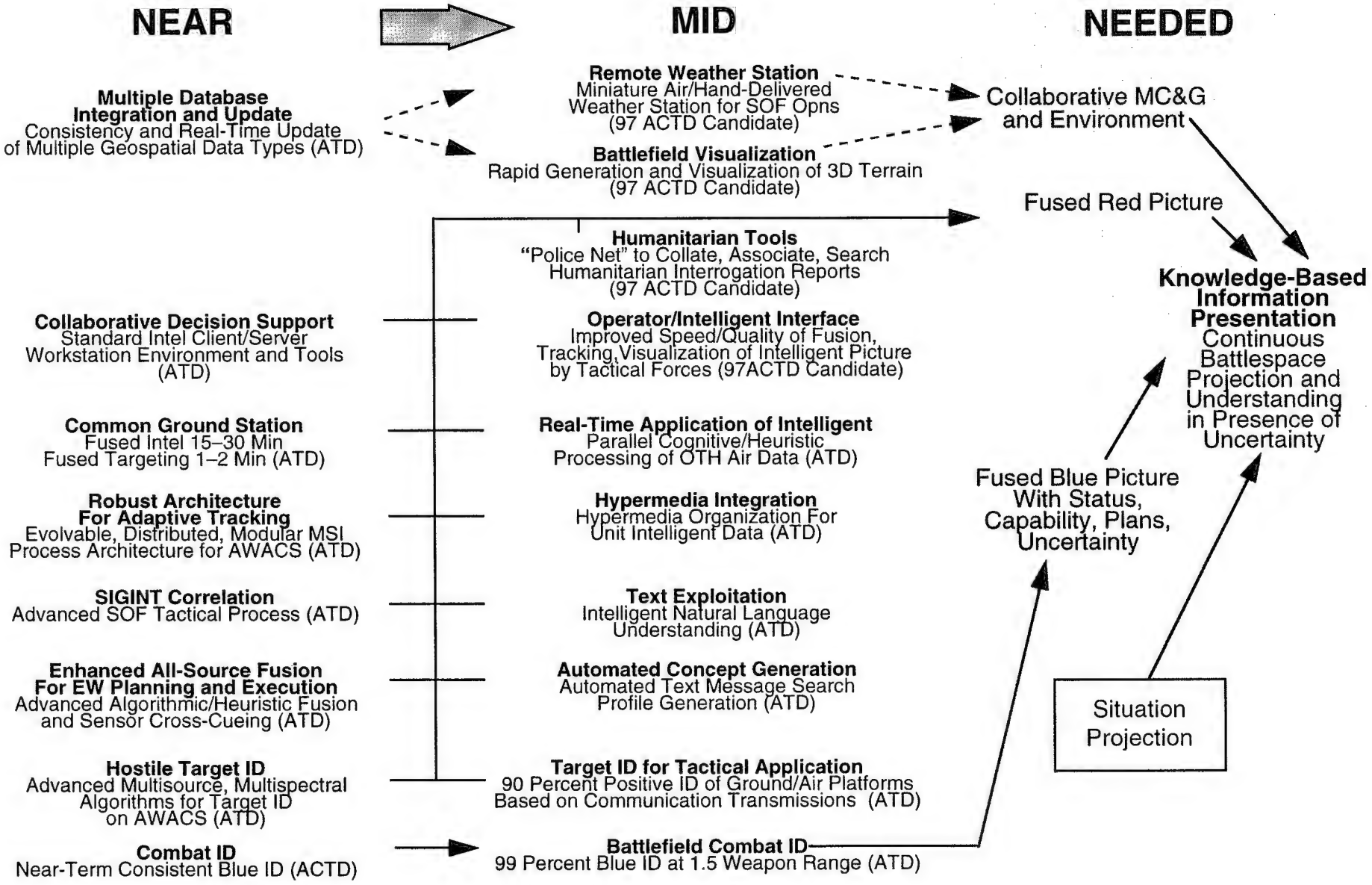
- Visibility of Mission, Centers of Gravity, Commander's Intent and Information Requirements to Dynamically Drive Coordinated Operations at All Levels Over Time (Current Operations, Future Operations, Future Plans)

- Tailored Visualization and Knowledge-Based Presentation of Situation, Plan, and Execution Status at Varying Levels of Aggregation
  - Tailored, Knowledge-Based Presentation
  - Intelligent, Distributed MC&G
  - Improved Multisource Fusion
  - Collaborative Situation Assessment and BDA
  - Blue Plans/Status Understanding
  - Situation Projection

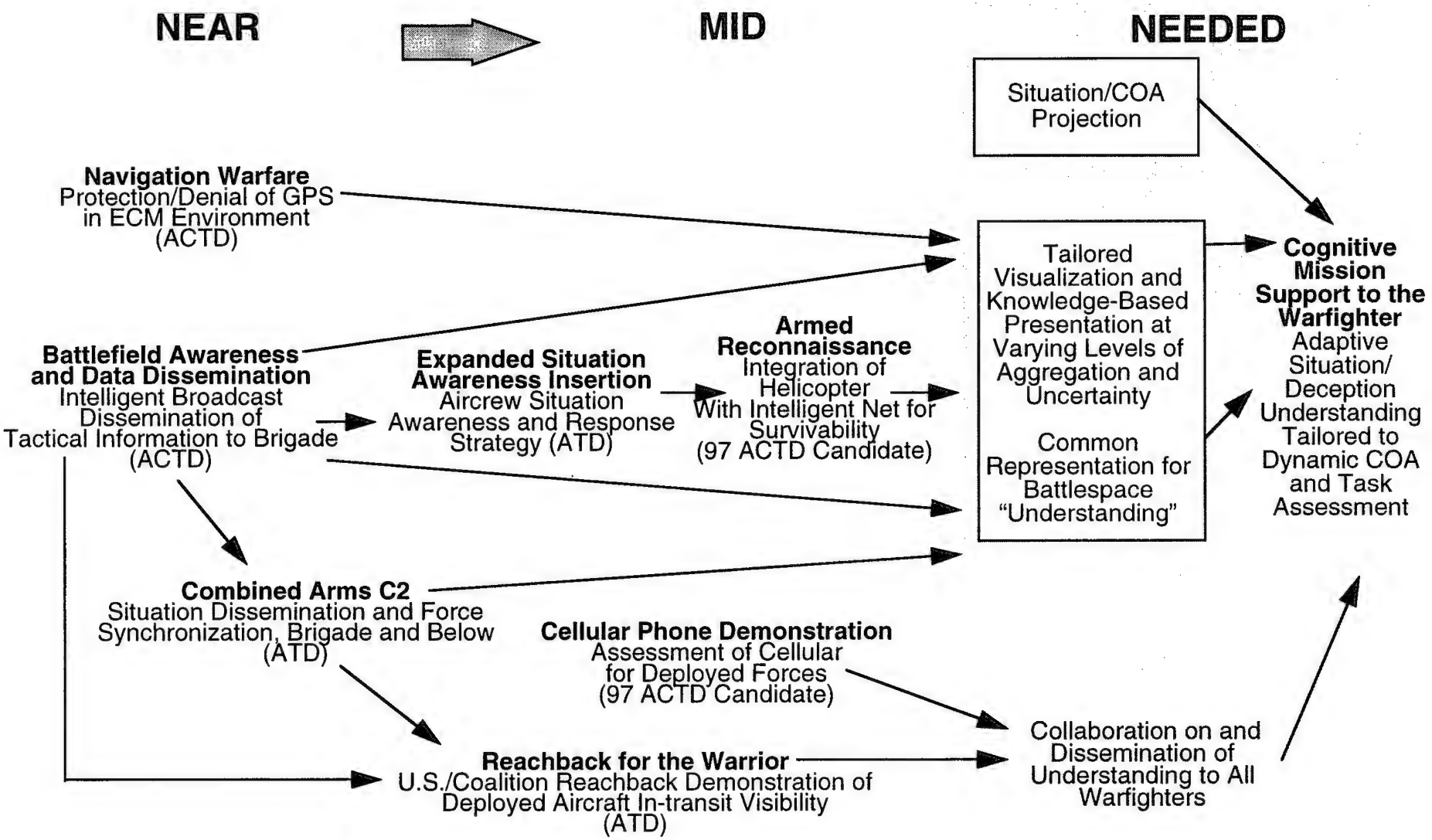
- Common Representation for Battlespace Understanding

- Collaboration and Dissemination of Understanding to All Warfighters

Current and Needed Operational Demonstrations



Current and Needed Operational Demonstrations



Potential Metrics for Demonstration Areas

Continuous Battlespace Understanding in the Presence of Uncertainty

- **Knowledge-Based Information Presentation**

  — ***On-line, Collaborative Access to Full Range of MC&G and Environmental Products Over 10,000's of Sq Km***
  - » 30-M Resolution "Smart Maps" in 10's of Minutes for Situation/Plan Reasoning; Auto Feature Extraction for Rapid All-Source Production
  - » 10M Resolution Maps in Minutes for Tactical and Targeting Situations
  - » Collaborative Mapping To Merge Commercial, Imagery, and Reconnaissance in Minutes, With Automatic Downgrade/Release Capability

  — ***Fused, All-Source Picture Tailored to Required Level of Aggregation and Security Classification***
  - » Enemy Forces Identified With Tactical Unit Association and Uncertainty
  - » Automated Association of Dissimilar Products (Images, SIGINT, etc.)
  - » 98 Percent Awareness of "Movers" Over 5,000 Sq Km Area
  - » Releasable Coalition Picture With <1-Min Delay
  - » Fusion and Access to Non-DoD Information at Specified "Quality of Service"

  — ***Fused Blue Picture That Reflects Status, Planned Events, Capabilities, and Uncertainty***

  — ***Situation Projection for Own and Enemy COA Estimation***
  - » Continuous 1- to 5-Min Projection for Designated Targets, 20-Min to 1-Hour Projection for "Movers" and 6- to 24-Hour Projection for Major Forces
  - » Uncertainty Projection and Management

Potential Metrics for Demonstration Areas *(Continued)*

Continuous Battlespace Understanding in the Presence of Hostile Activities and Deception

- **Cognitive Mission Support to the Warfighter**
  - ***Tailored Visualization and Knowledge-Based Presentation of Situation, Plan, and Execution Status at Varying Levels of Aggregation***
    - » Visibility of Mission, Centers of Gravity, Commander's Intent, and Information Requirements to Dynamically Drive Coordinated Operations at Levels of Detail (Crisis Action, Current Operations, Future Operations, Future Plans)
    - » Mission Readiness Matched to Mission and Task Requirements
    - » Mission Capabilities Projected Versus Weather, Terrain, and Logistics Constraints
  - ***Collaborative Situation and BDA Assessment Among Intelligent Centers***
    - » Resolution of Differing Assessments of Situation Within Decision Cycle (Minutes for Time-Critical Tactical Decisions and BDA, 10's of Minutes for Force Coordination Decisions)
    - » Deception Recovery; Protection and Tolerance of GPS Degradation
  - ***Common Representation for Battlespace Understanding***
    - » Representation of Completeness, Uncertainty, and Deception Indicators
  - ***Collaboration on and Dissemination of Understanding to All Warfighters***

Consistent Battlespace Understanding

Goal

Elevate the Level of Cognitive Understanding of the Enemy, Friendly, and Geospatial Situation; and Maintain Consistency in That View Across Tactical and Supporting Forces.

Current Limitations

- No Common Operational Picture
- Inadequate Information Support for Commander's Decision Needs
- Presently Too Much Information Without Quality Threshold; Not Scaleable
- Text-Message Intensive With No Automated Machine Understanding
- Inadequate Dissemination of Understanding
- IPB Degrades When Battle Begins

Critical New Functional Capabilities

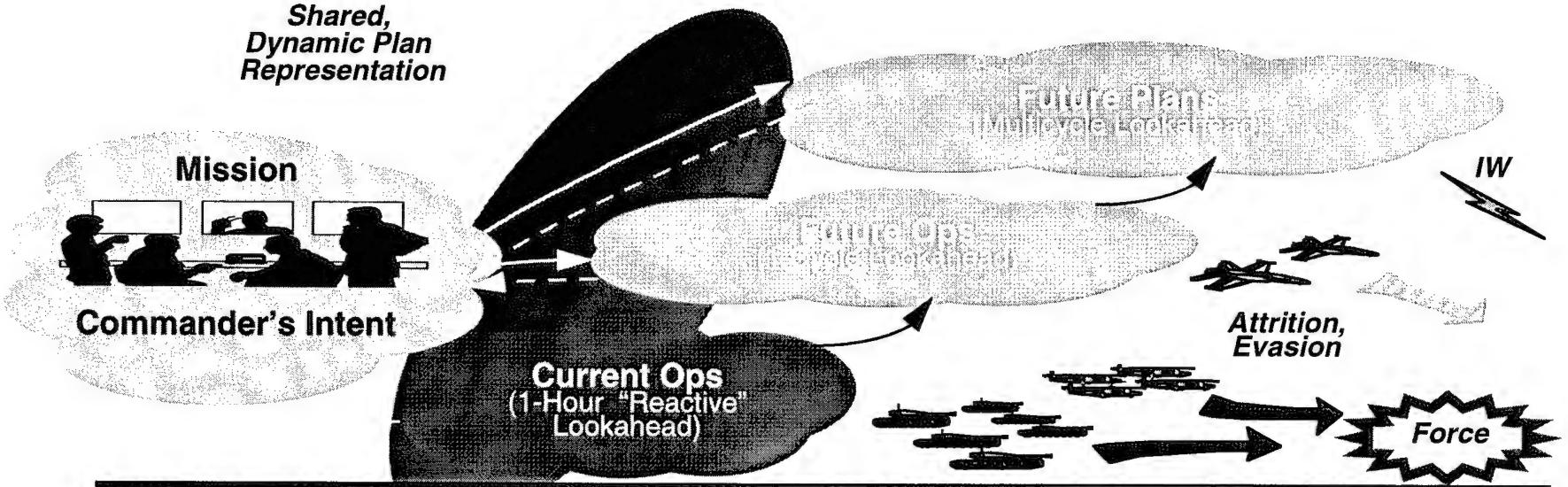
- National and Theater Intelligence Processing for Broadcast
  - Sensor Fusion
- Force Status and Execution Following
- Intelligent, Distributed MC&G
- Collaborative Situation Assessment, BDA, ATR
  - Visualizing Centers of Gravity, Commander's Intent, and Plans
- Common Understanding Representation Including Commander's Intent With Access and Assimilation by Warfighters
- Situation Projection
- Parallel Dissemination of Intelligence/BDA to C2 and Shooters
- Rapid, Accurate Target Information (Target Location and Recognition, Situation Awareness in Target Area)

Needed Technology

- Real-time Distributed Object Management
- Intelligent Agents
- Cognitive Support and Automated Decision Aids, Including Text and Speech Recognition
- Cognitive Displays, Vitual Reality, and 4D Real-Time Presentation
- Automated Recognition, Routing, and Analysis of Information
- ATR, BDA
- Automatic Data Validation and Tagging
  - Heterogeneous Database/Information Search and Retrieval
- Distributed, Collaborative, Virtual Workspaces
- Multisensor and Information Fusion, Sensor Cross-Cueing
- Rapid Modeling and Simulation for Situation Assessment and COA Analysis, Including C3I
- Intelligent, Object-Oriented Maps
- Image Understanding and Pattern Recognition
- Uncertainty Management and Visualization

Predictive Planning and Preemption

Goal:
Lean Forward in the Planning Process To Avoid Direct Confrontation (by Employing Alternative Means), To Be Prepared To React and Exploit Opportunities When Direct Confrontation Must Occur, and Shape the Expected Actions To Stay Within the Enemy's Decision Cycle and Keep Him Out of Ours. Includes Incremental Force Projection: Fight From Any State; Flexible Combination of Tailored Early Force Packages, Global Reach, Accelerated Deployment, Virtual Deployment, and Reachback



Operational Concepts (Forces)

- Emerging "Extended Staff" Organizations
  - — Current Operations, Future Operations, Future Plans *(Versus J-Codes)*

- Countermove Planning
  - — Anticipate Enemy Moves and Shape the Battle To Deny Those Moves and Dominate the Decision Cycle
    - » Exploit the "Empty Battlespace" — Manipulate the Space/Time/Spectrum/ Resources Continuum
  - — Precision Attrition as an Option
    - » Delayed, Selective, Surgical Engagement
    - » Attack Sensors, Communications, Command Posts To Disrupt Control of Weapons *(Versus Attacking Weapons)*

- Information As the Focus of Operations
  - — Operations Unfold Before a Global Audience
  - — Information Warfare as an Integrated Option
  - — Spectrum Dominance: *Protect Friendly Information Systems While Denying Enemy Use of His Systems*

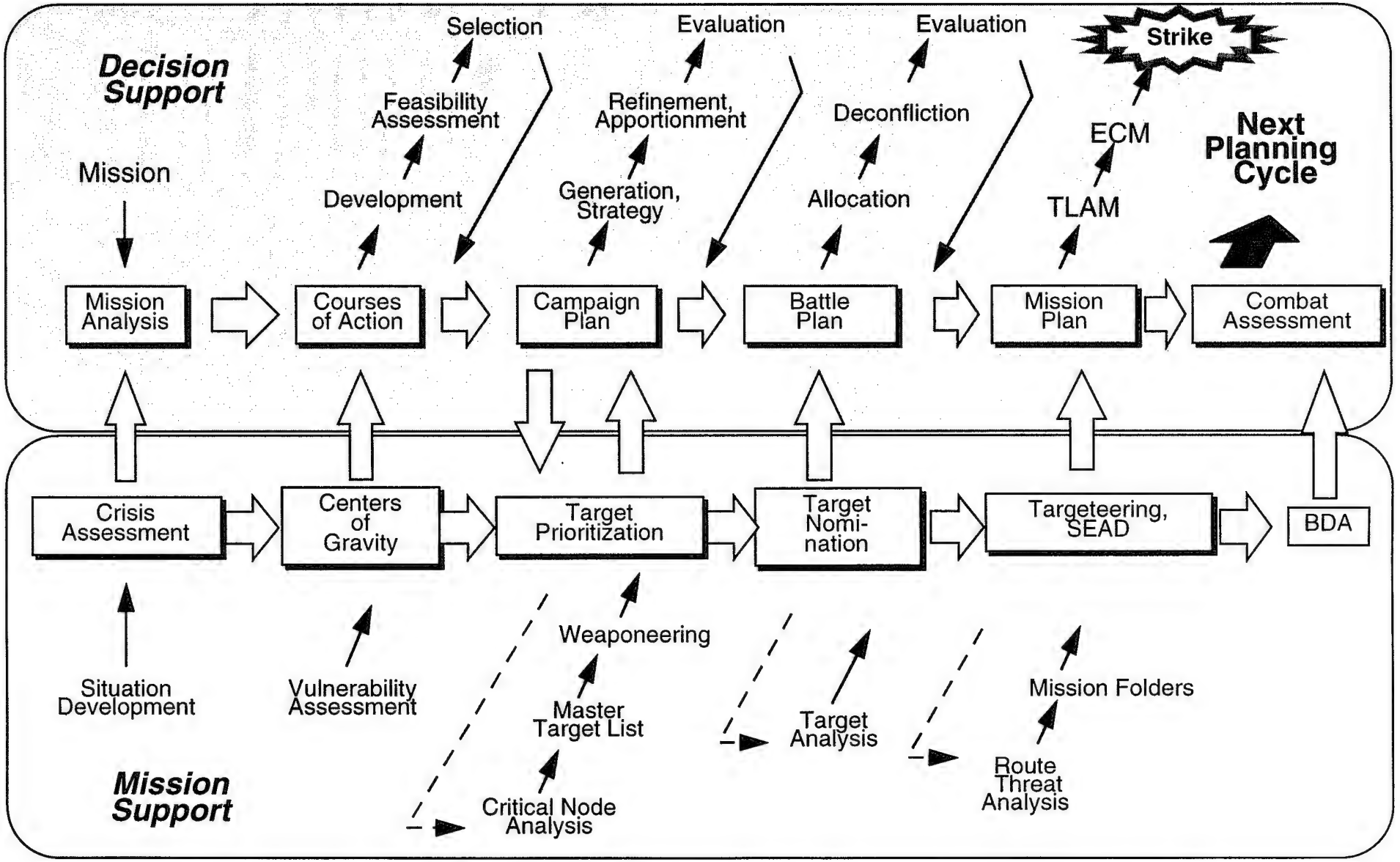
- Planning to Support Synchronized Operations in the Extended Battlespace
  - — Widely Dispersed Forces (Inter- and Intratheater)
  - — Nonlinear Actions

- Support NRT Feedback Replanning/Plan Repair
-
- Plan Analysis and Assessment/Preview/Rehearsal as Integral Part of Warfighter C4I

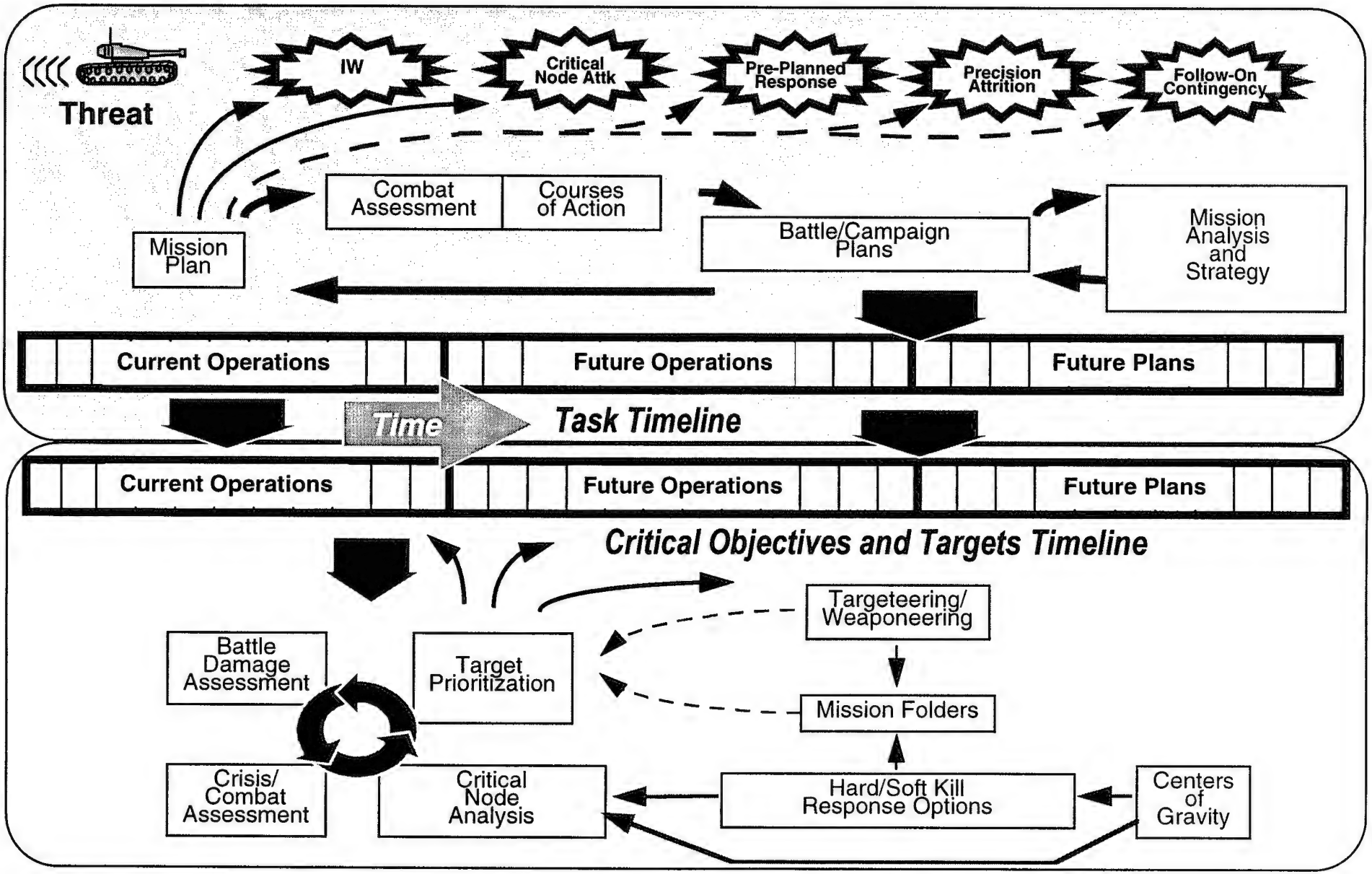
C2I Operational Concepts

- Continuous Replanning Cycle (Sliding Window)
  - — Distributed, Dynamic Continuity of Campaign, Battle, Mission Planning, and Mission Support Requirements
  - — Anticipatory Mission Plan Package Development To Reduce Response Cycle
    - » *Prepositioned Essential Information, Plans, and Analysis Packages*
  - — Distributed Continuity of Planning, Preview, and Rehearsal Across Echelons and Missions
- Dynamic Information Resources Management
  - — Spectrum/Bandwidth Management
  - — Defensive IW To Ensure Own Force Use of Resources
  - — Offensive IW To Deny Enemy Use of Resources
- Rapid System Tailoring To Adapt to Threat
  - — Modular, Distributed Systems; Over-the-Air System Updates
- Battle Command
  - — Integrated Planning Across Warfare Areas (Horizontal)
  - — Nonhierarchical Information Flow
  - — Intuitive Plan Presentations
  - — NRT Planning (Continuous Execution Feedback Loop)
- Distributed Interactive Simulation
  - — Wargaming
  - — Analysis
  - — Rehearsal
- Coherent Situation Representation From Preconflict Through End of the Crisis

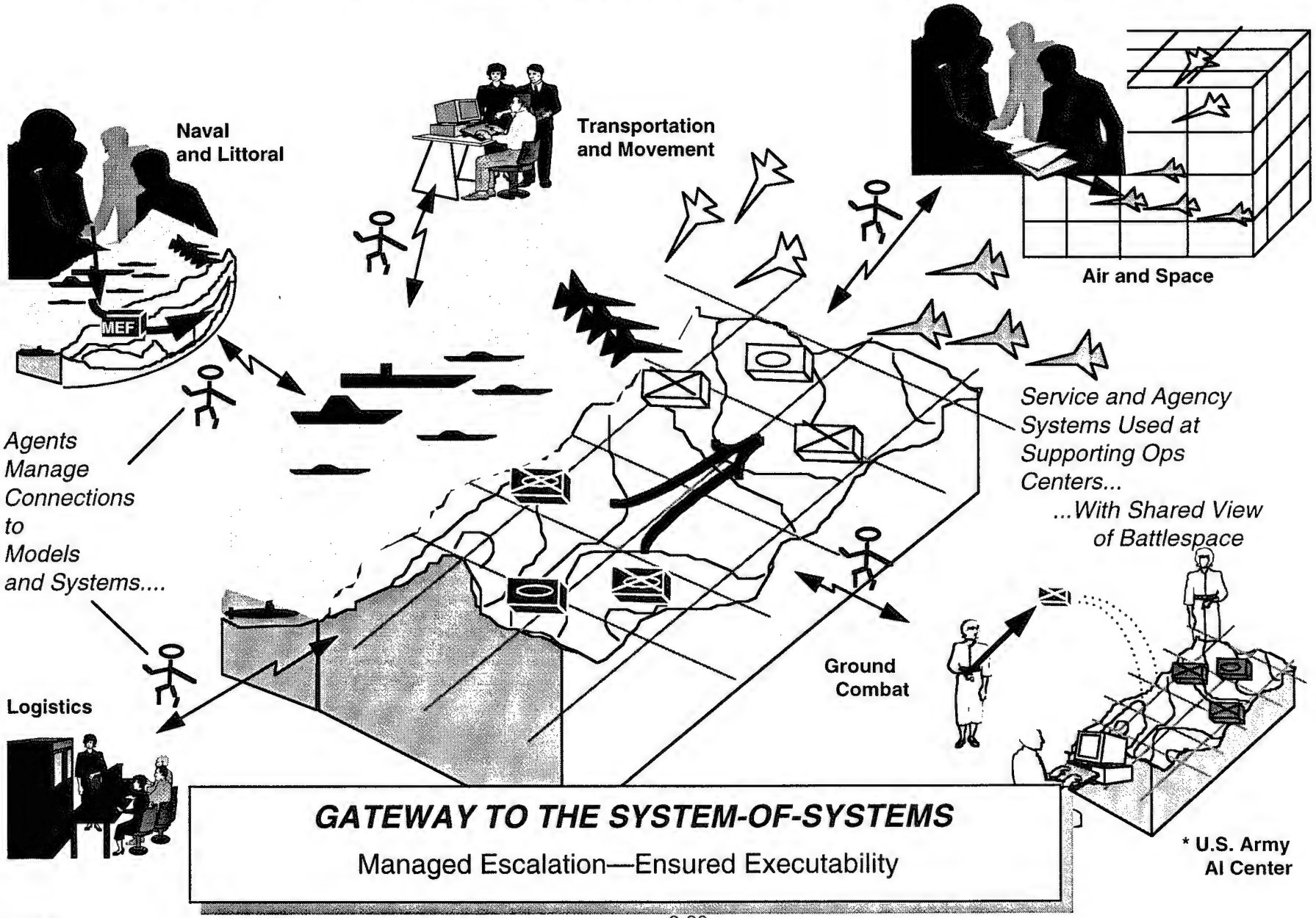
Empty Battlespace Opportunity Planning-Current



Empty Battlespace Opportunity Planning—Reengineered



Empty Battlespace Opportunity Planning—Reengineered*



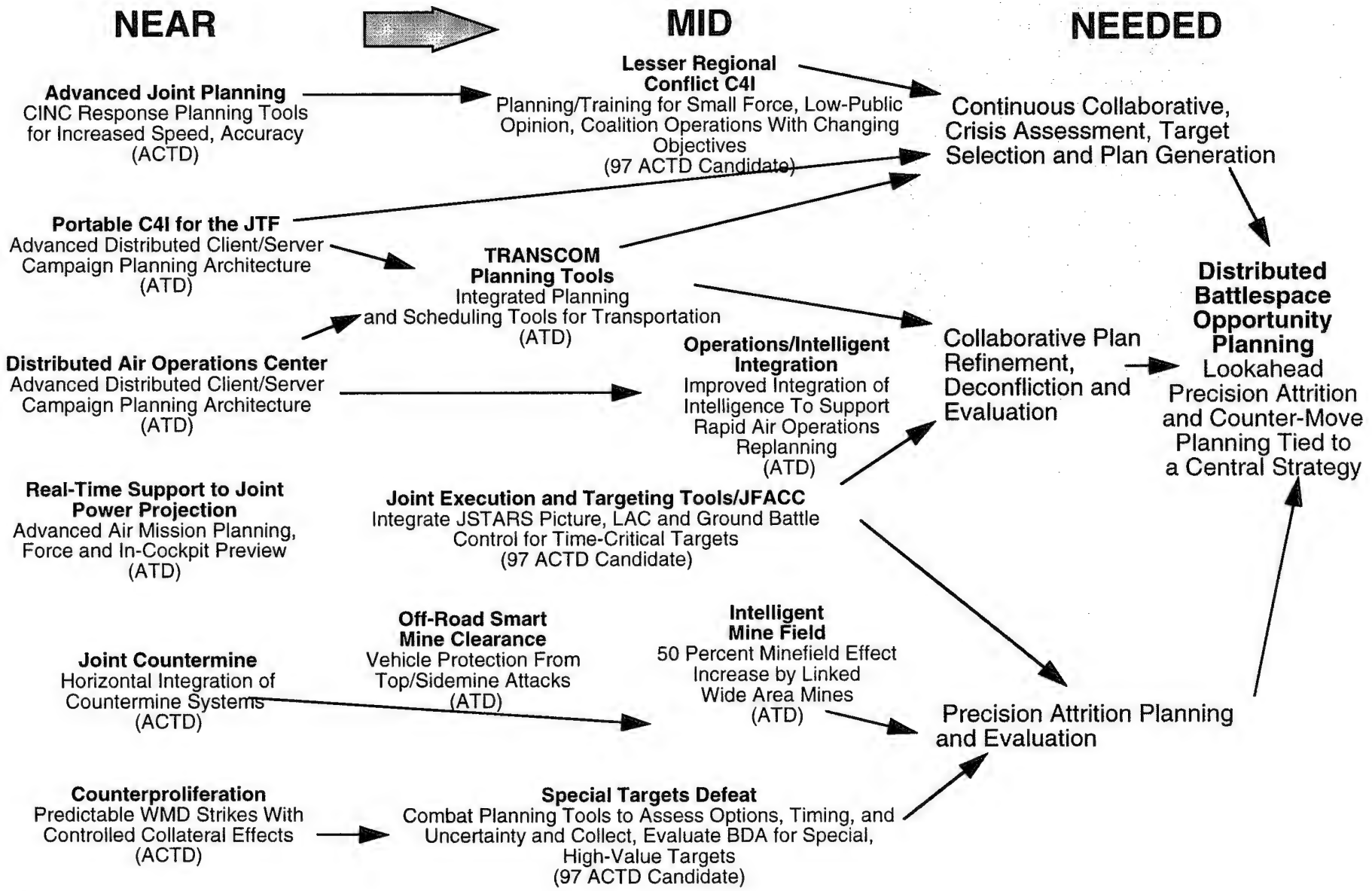
Current Limitations	Causes	Detailed Critical Functional Capabilities	Technology Challenges
Automated Planning Systems Are Not Prepared to Continuously Exploit Follow-on Opportunities When They Arise	Inadequate Planning Capacity; No Effective, On-line COA Projection Capability	Shared, Dynamic Plan Representation Linked To Central Strategy *(Intuitive Plan Representations)*	Continuous, "Sliding" Planning Window Across Campaign, Battle, Mission Continuous Projection of COAs at All Levels Seamless, Cross-Echelon Plan Management
	Absence of Good Automated Countermove Planning or What-If Analysis	Precision Attrition Planning and Evauation	Optimization of Time, Space, Forces, Spectrum Options on Empty Battlespace Windows of Opportunity Dynamic, Distributed Critical Node Analysis and Simulation of Complex COAs and Response Options
Integrated Wargaming Is Not Embedded in C2I and Cannot Be Used for On-line Plan Evaluation	Slower Than Real-Time Precision Aggregate Level Simulation Lack of Distributed, Consistent Data at All Levels	Collaborative Plan Refinement, Deconfliction and Evaluation	Deconfliction Across Mission Areas, C2I/Logistics Boundaries, Shared Objectives Integrated, Cooperative Decision Making and Simulation for Plan Refinement, Deconfliction, and Evaluation

Current Limitations	Causes	Detailed Critical Functional Capabilities	Technology Challenges
Information Warfare Not Integrated With Hard Kill as a Continuum of Tactical Options	No Accepted Soft Kill Effects Assessment	Information Warfare Planning Capability	Just-in-Time Composite Soft Kill Effects Assessment, Mission Package Construction and Delivery, Recursive Based on Adaptive Assessment and Prediction
Failure to Fully Exploit Frequency Spectrum As a Theater Weapon	No Joint Spectrum Coordination in Offensive and Defensive Operations	Spectrum Dominance Planning/Monitoring and Control Capability	Computation/Monitoring of Complex Spectrum Effects, and Dynamic Optimization of Own Force Spectrum Use
Lack of Distributed, Consistent Data at All Levels	Information Search and Retrieval Can "Choke" at Times of Peak Demand	Rapidly Tailorable Plans and Updates	Over-the-Air Updates
Sensor Tasking and Countermeasures Are "Reactive" to Emergent I&W Rather Than Anticipatory	Sequential Planning Cycle	Collaborative, Combined-Arms Crisis Assessment, Target Selection And Plan Generation (Coherent Situation Representation)	"Just-in-Time" Mission Package Construction and Delivery, Recursive Based on Adaptive Assessment and Prediction Tailorable Opposing Forces for Enemy COAs

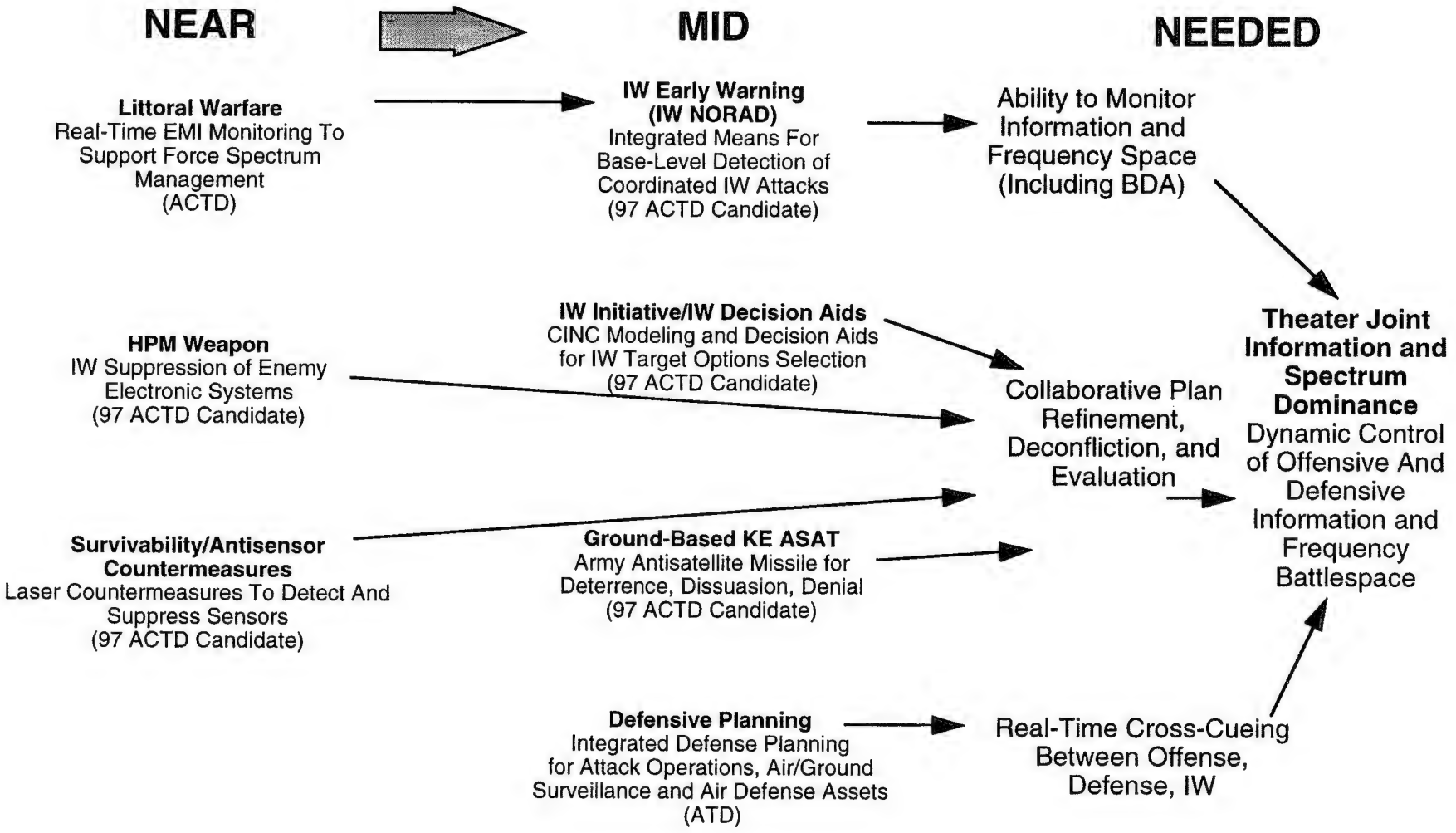
Detailed Critical Functional Capabilities Summary

- Shared, Dynamic Plan Representation Linked to Central Strategy
  - — Current Operations, Future Operations, Future Plans
  - — Continuous, Sliding Plan Window
- Collaborative Crisis Assessment and Plan Generation
  - — Exploit Time/Space/Force/Spectrum Options
  - — Seamless Across Echelons, Missions, Services
  - — Anticipatory Countermove Planning (Reactive, Exploitive)
- Collaborative Plan Refinement, Deconfliction, Evaluation
- Precision Attrition Planning and Evaluation
  - — Attack Ability to Control Weapons Versus Attacking Weapons
- Information Warfare Planning Capability
  - — Protect Own, Deny Enemy's
- Spectrum Dominance Planning/Monitoring and Control Capability
- Rapidly Tailorable Systems and Updates

Current and Needed Operational Demonstrations



Current and Needed Operational Demonstrations *(Continued)*



Potential Metrics for Demonstration Areas

- **Distributed Battlespace Opportunity Planning (Look-Ahead, Multioption Optimization to a Central Offensive and Defensive Strategy Across Time, Space, Resources, Spectrum)**
  - ***Collaborative, Combined-Arms Crisis Assessment, Target Selection, and Plan Generation on a Continuous Basis***
    - » Continuous, Dynamic Critical Node Analysis on Projected Enemy Situation of 1,000's of Units To Determine Decisive Options (100's) on 10's of Centers of Gravity
    - » Countermove Planning To Generate 2–6 Sequences of Options for Countering Anticipated and High-Possibility Moves for Moving Units and Critical Nodes, Including Dispersion/Signature Management
  - ***Collaborative Plan Refinement, Deconfliction, and Evaluation***
    - » Local Tactical Simulation of Plan/Countermeasures Options in Minutes; Remote, Multimission, High-Fidelity Plan or Countermeasure Simulation and Assessment Within 1–6 Hours Depending on Fidelity
  - ***Rapidly Tailorable Systems and Updates***
    - » 90 Percent Reprogrammability of Threat Response Options/Techniques
    - » Transparency/Relocatability of Predictive Models and Tactics/Techniques/Threat-Dependent Software Over the Air in Hours

Potential Metrics for Demonstration Areas *(Continued)*

- **Distributed Battlespace Opportunity Planning *(Continued)***
  (Look-Ahead, Multioption Optimization to a Central Offensive and Defensive Strategy Across Time, Space, Resources, Spectrum)
  - — ***Precision Attrition Planning and Evaluation***
    - » Integrated IW, C2W, Hard-Kill Options Generated and Evaluated in 10's of Minutes for 10's of Critical Targets
    - » Stealth and Enhanced Penetration/Minimum Collateral Damage/WMD Options Planning in <1 Hour for Hardened Facilities and Well-Defended Sites

- **Theaterwide Joint Information and Spectrum Dominance**
  - — ***Ability To Monitor Information and Frequency Space***
    - » IW/C2W BDA Assessment Capability for Critical Nodes, Events
  - — ***Predictive Control of IW and C2W Options***
    - » Distributed, High-Fidelity Simulation of Effects Versus "Cost" of IW and C2W Options From Rear-Echelon Anchor Desks in Hours
    - » Prepositioning of IW and C2W Countermeasures Parametric Data and Coordination Information in 10's of Minutes

Predictive Planning and Preemption

Goal

Lean Forward in the Planning Process to Avoid Direct Confrontation (by Employing Alternative Means); Be Prepared to React and Exploit Opportunities When Direct Confrontation Must Occur, and to Shape the Expected Actions to Stay Inside the Enemy's Decision Cycle and Keep Him Out of Ours.

Incremental Force Projection—Fight From Any State and Flexible Combination of Tailored Early Force Packages, Global Reach, Accelerated Deployment, Virtual Deployment, and Reachback

Limitations

- Automated Planning Systems Are Not Dynamic and Robust
- Wargaming Not Integrated in C2I and Cannot Be Used for On-line Planning Evaluation
- Sensor Tasking and Countermeasures Are Reactive to Emergent IW
- IW Not Integrated With Hard-Kill as a Continuum of Tactical Options
- Failure to Exploit Frequency Spectrum as a Theater Weapon
- Lack of Distributed, Consistent Data at All Levels
- Full-Up Planning Requires Large Vulnerable Footprint in Theater
- Inadequate Support for Operations Using Tailored Forces
- Planning With Coalition and Humanitarian Forces Is Inadequate

Critical Functional Capabilities

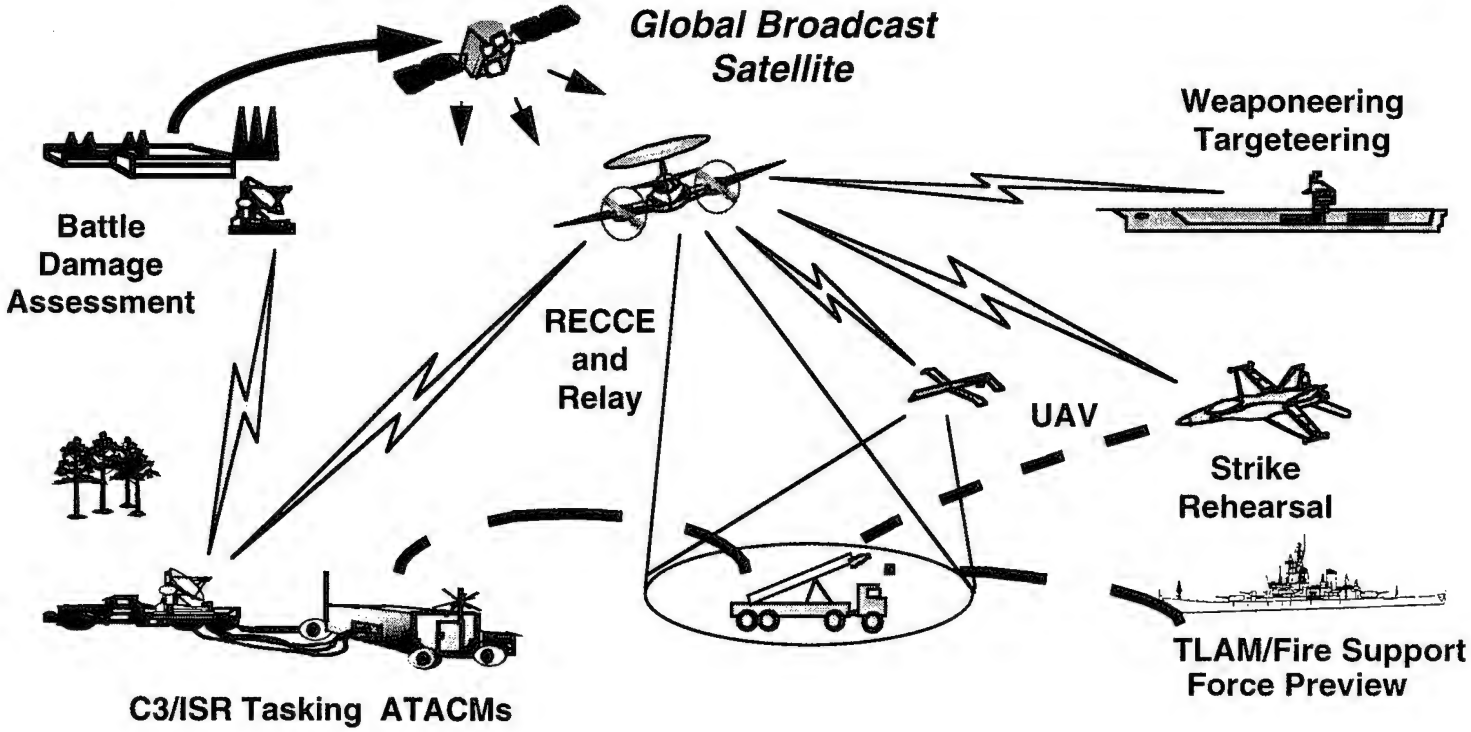
- Collaborative Situation Assessment, BDA, ATR, and Planning
  - Precision Attrition Planning and Evaluation
- Situation and Command Projection
- IW and Spectrum Dominance Monitoring, Planning, and Execution
- Dynamic Tasking Tied to Central Strategy Throughout the Joint Force
- Repair and Consumables Management
- Shared, Dynamic, Distributed, Continuous Collaborative Planning
  - Rapidly Tailorable
  - Crises
  - Incremental Force Projection Requirements
- Automated Mission-to-Target and Weapon-to-Target Pairing

Needed Technologies

- Rapid C3I Modeling and Simulation
  - Spectrum Dominance and IW
  - Situation Projection
  - Red, Blue, White COA Assessments
  - Fault-Tolerant M&S for Mission, Rehearsal, Preview, Training
- Distributed, Collaborative, Continuous Dynamic Dlanning
  - Plug-and-Play Architecture
  - Automated Weapon Target Pairings
- Virtual Anchor Desk Analysis
  - Heterogeneous Information Fusion
  - Automated Nodal Analysis

Precision Information Direction

Goal:
Enable the On-scene Commander to Exploit and Shape the Battlespace by Dynamically Directing and Integrating (in Accordance With Operation, Battle, and Mission Priorities) Both Tactical and Supporting ISR Resources for Targeting, Weaponeering, Mission Preview, BDA, and Combat Assessment *(to Facilitate the Application of Precision Weapons, Precision Forces, and Rapid Response)*



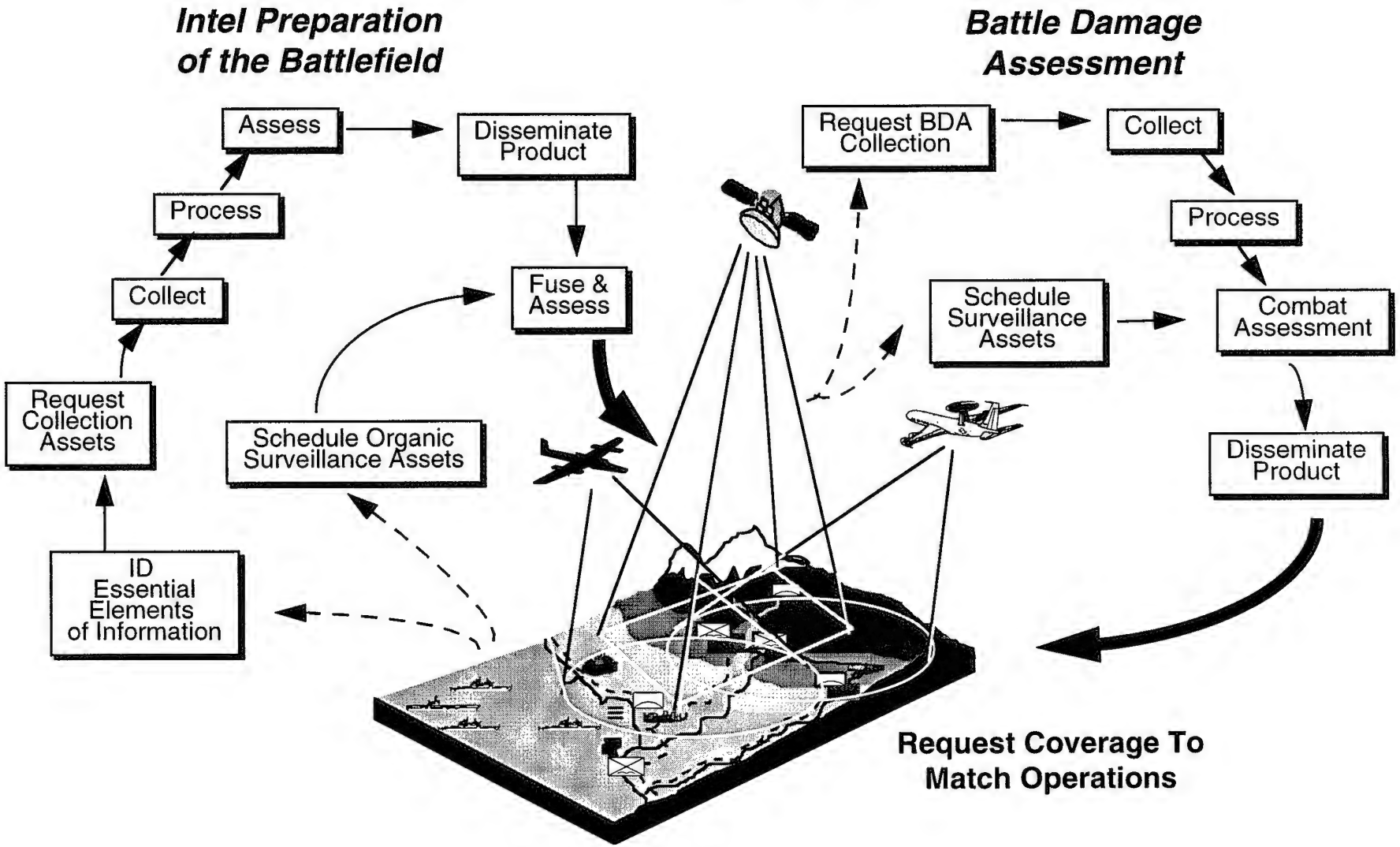
Operational Concepts (Forces)

- Flexible Application of Force To Shape and Set Tempo of the Battle Into Areas Where Adequate ISR Coverage Can Be Maintained
- High-Value Targets at Risk Throughout the Battlespace (Align Targeting to Campaign Goals)
- Tight Integration of Real-Time, Directed BDA, and Retasking Between the Forward Echelon and Supporting Assets
  - — Close Integration of Offense With Defense
  - — Synchronization of Surveillance and Strike Assets To Facilitate Shoot-Look-Shoot
  - — Raise the Combination of UAVs and Nonorganic Assets to the Level of Performance of TAC RECCE

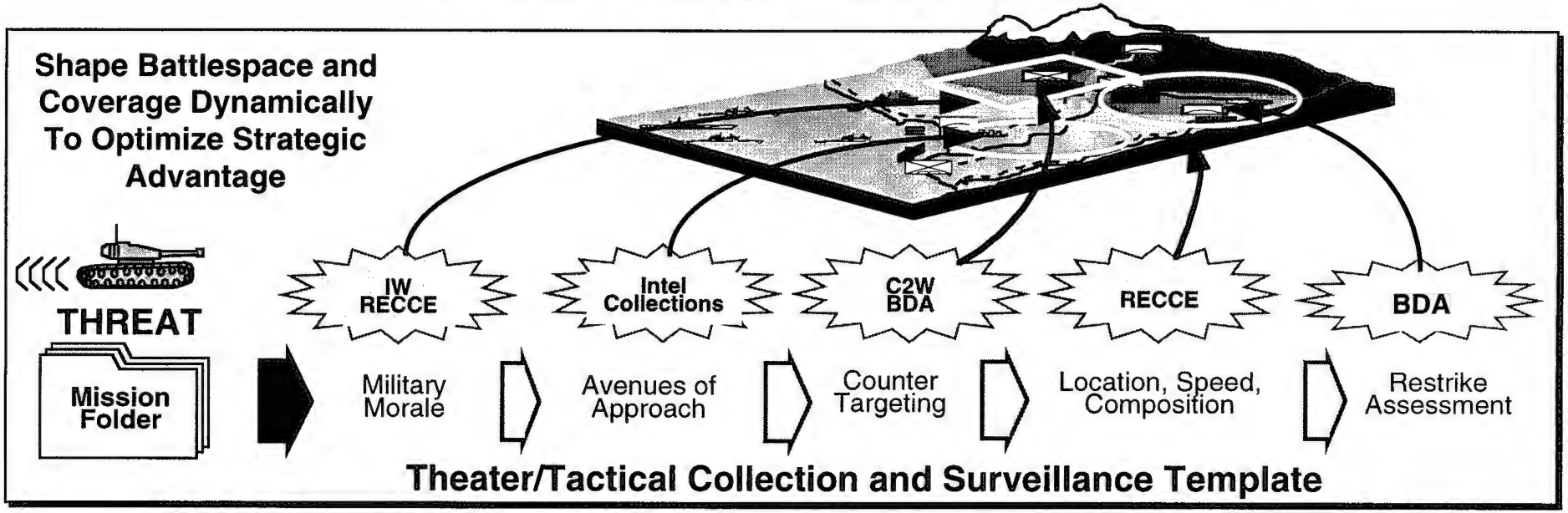
C2I Operational Concepts

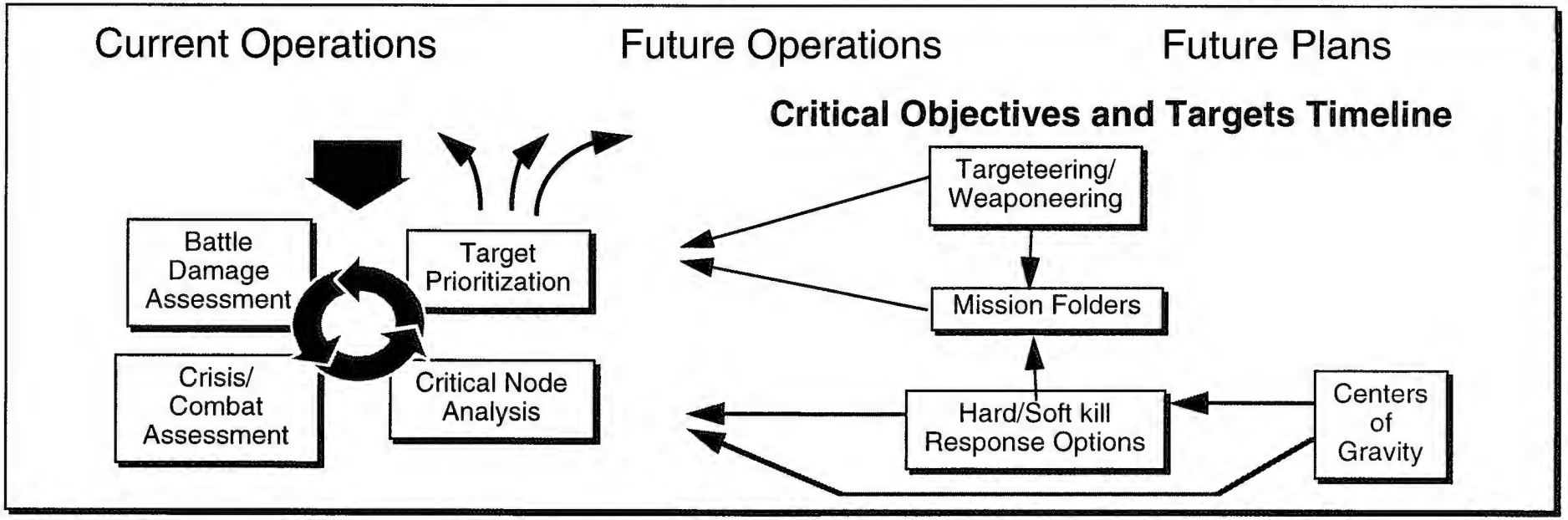
- Dynamic, Central Targeting Strategy Tied to Mission Priorities and ISR Coverage *("Maneuver to ISR")*
  - — Direct Support Assets Under Local Control
  - — Conflicting Requirements, Excess Capability Subject to Joint Scheduling *(e.g., Plan Repair, Air/Fire Support Target Handoff)*
  - — Visibility of Real-Time Mission Support Tasking Requirements and Priorities by Intelligence/RECCE/ Analysis Providers
- Automated, Near Real-Time Location, ID, Assessment, and Weaponeering of Critical Threats and Targets Consistent With Dynamic, Integrated Priorities
  - — Dynamic Critical Node Analysis
  - — Automated Target Exploitation, Targeteering, Weaponeering, BDA Interpretation, and Retargeting
- Distributed Analysis for Target Development, Weaponeering, BDA, Combat Assessment *(Distributed Mission Folders)*
- Just-in-Time Retargeting and Mission Materials, Visual Aids, and Previews to the Cockpit or Mission Team
  - — Real-Time, Direct Broadcast to the Warfighter

System Concept—Current

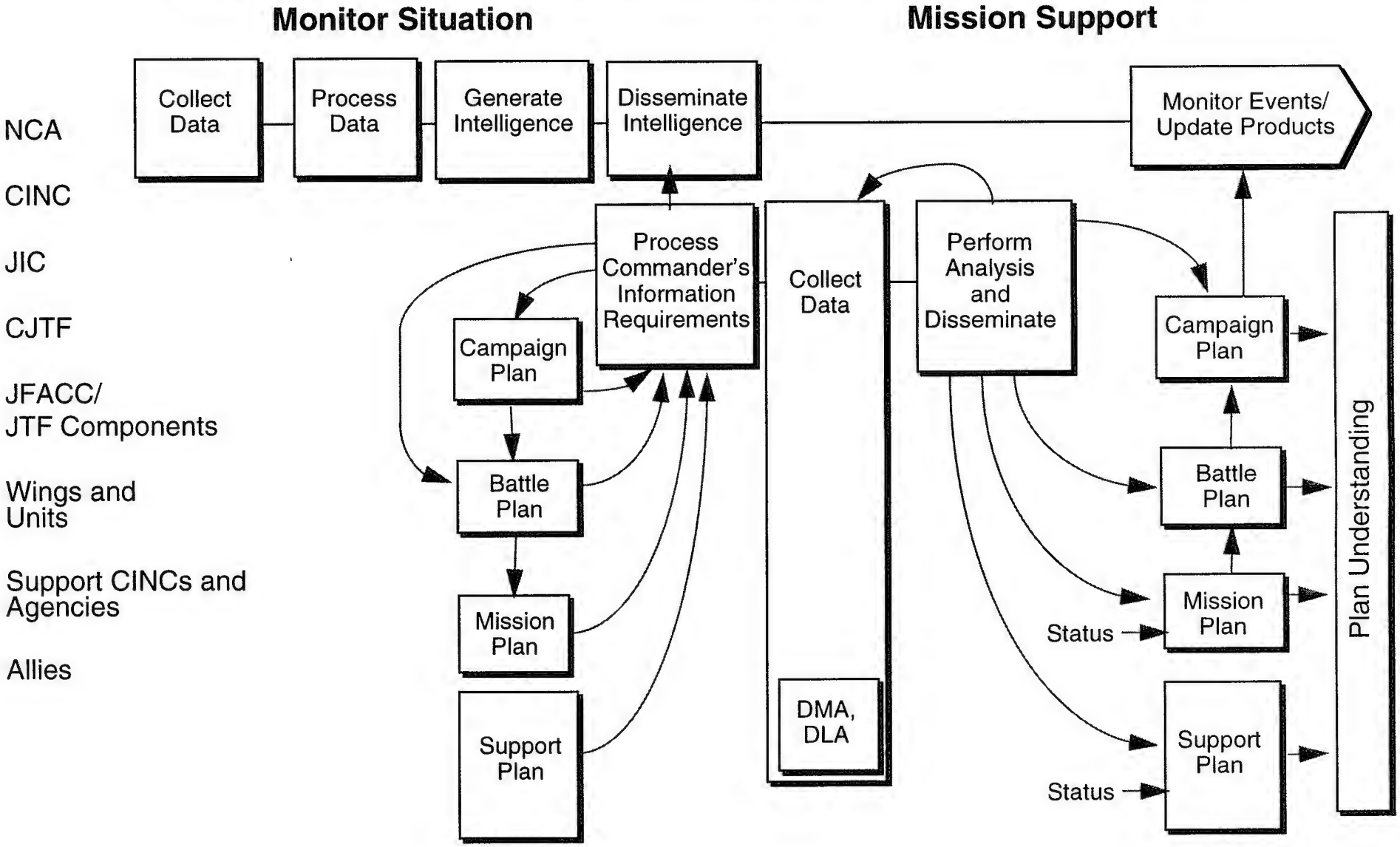


System Concept—Reengineered

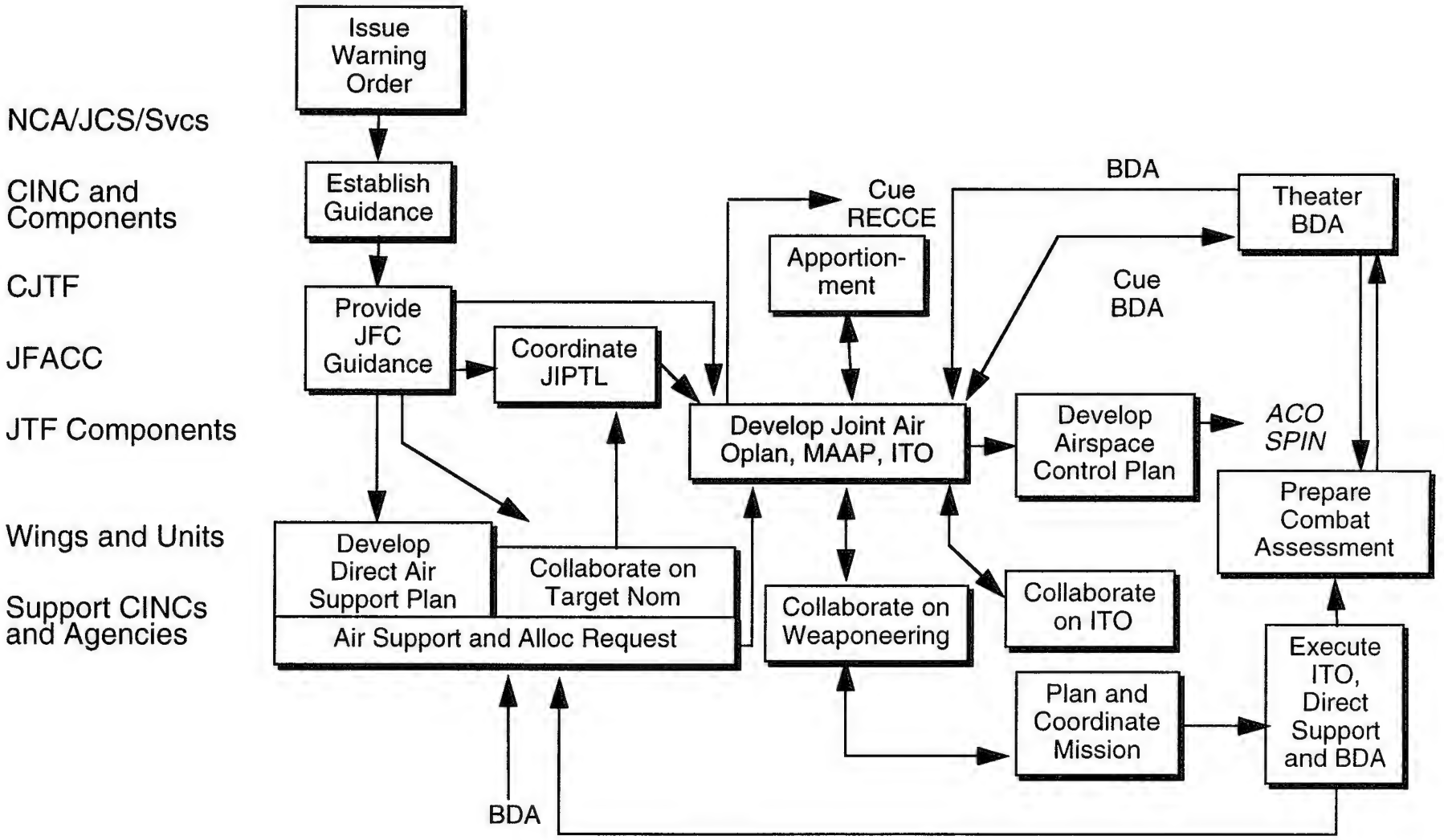




Reengineered RECCE/Collection Nomination Process



Reengineered Target Development/BDA Process

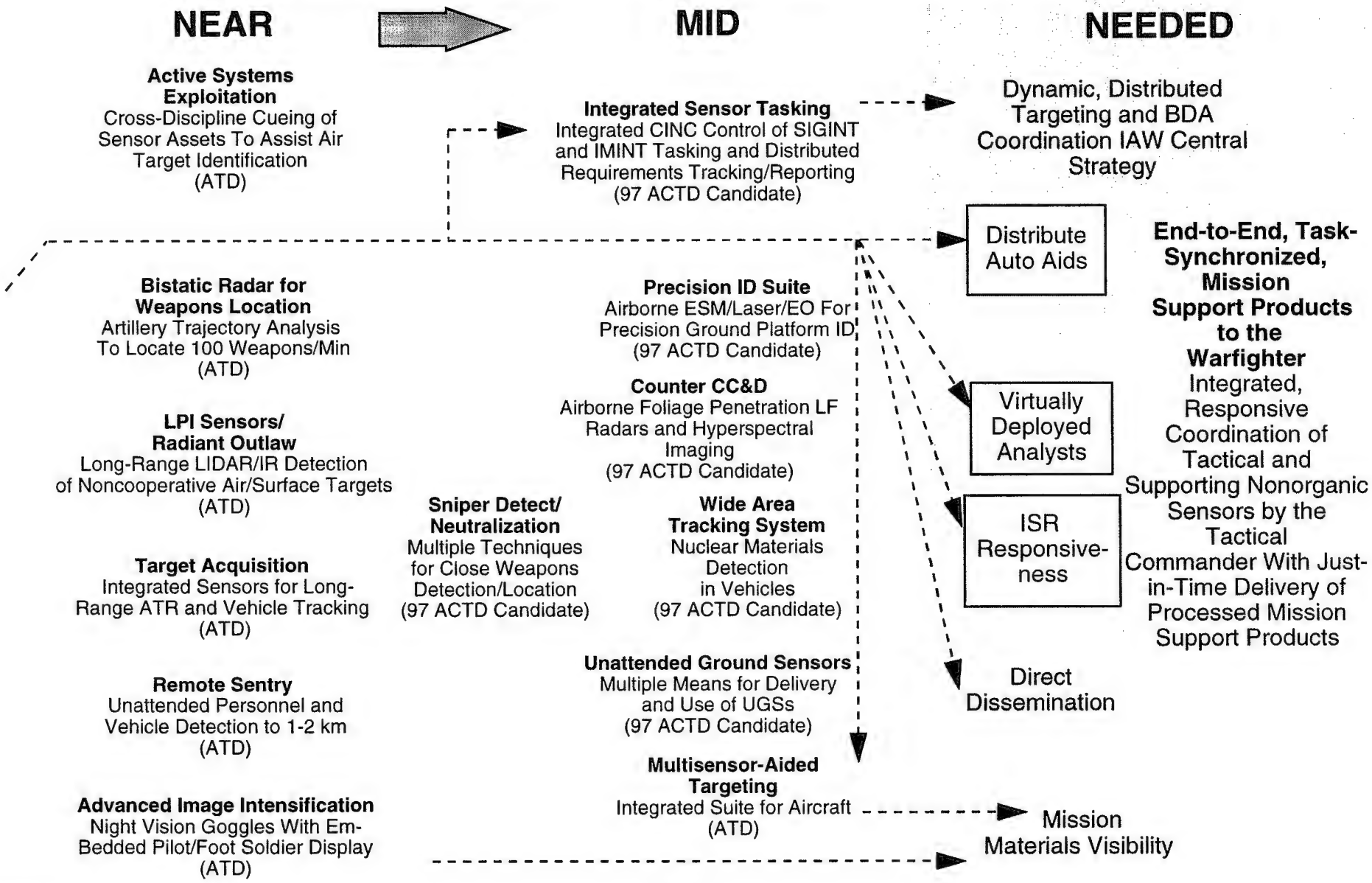


Current Limitations	Causes	Detailed Critical Functional Capabilities	Technology Challenges
Limited Response to Battlespace Changes	Rigid ISR Allocation and Tasking Cycle Lack of Visibility Into Sensor Tasking and Coverage	Dynamic, Central Targeting Strategy Tied to ISR Coverage and Mission Support Package Availability	Distributed Visibility of Sensor Tasking and Information Availability Distributed, Predictive Sensor Coverage Assessment
Limited Ability To Keep Stressing Targets at Risk	Limited Ability To Focus on High Value Targets	Automated Aids for Location, ID, Target Assessment, Weaponeering, BDA, and Combat Assessment	Dynamic Critical Node Analysis and Target Prioritization Image/Signal ATR, Interpretation
Campaign Impacts	Lack of Responsive Targeting Information	Distributed Analysis for Target Development, Weaponeering, BDA, Combat Assessment	Integrated, Shared Tasking for Shared Assets Distributed Mission Folders and Collaboration
	Operations Loosely Coupled to Campaign Objectives	Just-in-Time Retargeting and Dissemination of Mission Materials, Visualization Aids, Previews, BDA to Cockpit, Mission Team	Adaptive HCI for Mission Preview, Cueing Compression for High-Quality, Low Data Rate Transmission
Sortie Impacts	Poor and Slow BDA	Direct Broadcast to and From the Warfighter	Downlink of ISR Data and Tasking; Uplink of Sensor Data and Tasks Information Requirements

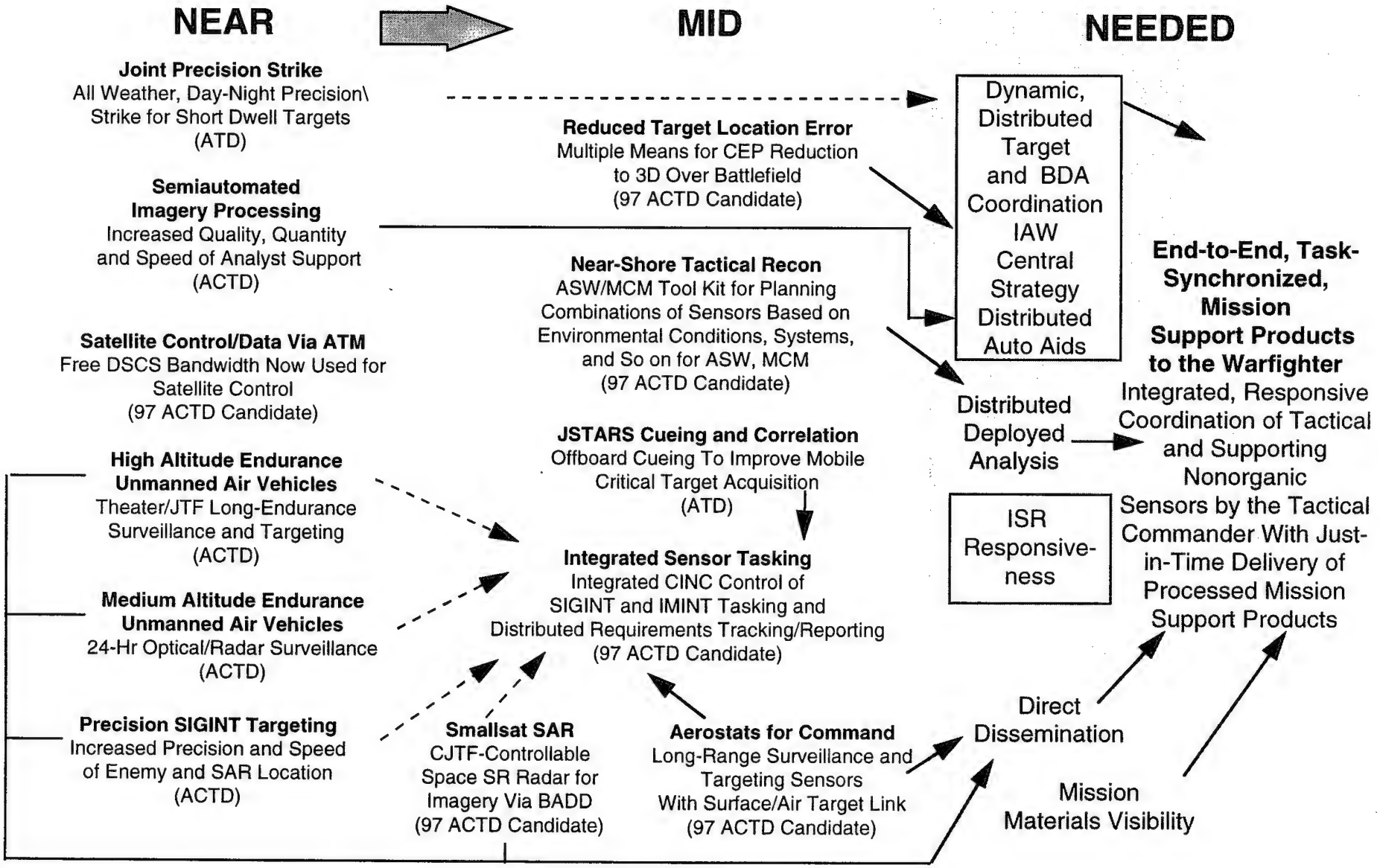
Detailed Critical Functional Capabilities Summary

- Dynamic Targeting Strategy Tied to ISR Coverage and Mission Support Package Availability
  - — Distributed Visibility of Sensor Tasking, Information Availability
  - — Distributed, Predictive Sensor Coverage Assessment
  - — Integrated, Shared Tasking for Shared Assets
- Automated Near-Real-Time Aids for Location, ID, Target Assessment, Weaponeering, BDA, and Combat Assessment
- Distributed Analysis for Target Development, Weaponeering, BDA, and Combat Assessment
  - — Distributed Mission Folders
- Just-in-Time Retargeting and Dissemination of Mission Materials, Visual Aids, Previews, and BDA to Cockpit/ Mission Team
- Direct Broadcast to the Warfighter
  - — Dissemination of Data and Tasking Status
  - — Uplink of Sensors and Collaborative Tasking Requirements

Current and Needed Operational Demonstrations



Current and Needed Operational Demonstration *(Continued)*



Potential Metrics for Demonstration Areas

- **End-to-End, Task-Synchronized, Multimission Support Products to the Warfighter (On-the-Move, Event-by-Event Mission Push)**
  - ***Dynamic, Distributed Joint Target/BDA Coordination Strategy for 1000's of Targets Across Theater of Operations***
    - » Near Real-Time Tactical Visibility of Multimission Target Priorities and Strategy (or Center of Gravity)-to-Task-to-Target Relationship
    - » Near Real-Time Tactical Visibility of Mission Support Package Available
    - » Near Real-Time Visibility of ISR Coverage at Tactical Level
    - » Near Real-Time Visibility of ISR Tasking/Availability
  - ***Distributed, Automated Aids for Time-Critical, Man-Intensive Processes***
    - » Automated Target Recognition to Locate/ID 1000's of Targets/Hour
    - » Automated Target Assessment/Targeteering to 1000's Targets/Hour
    - » Automated Weaponeering of 100's of Targets/Hour
    - » Automated BDA/Combat Assessment of 100's of Targets/Hour
  - ***On-line, Collaborative Access to Distributed Deployed Analysis for Target Assessment, Weaponeering, BDA, Combat Assessment at 10's of Sites***

Potential Metrics for Demonstration Areas *(Continued)*

- **End-to-End, Task-Synchronized, Multimission Support Products to the Warfighter**
  - ***ISR Responsiveness and Awareness at the Tactical Level***
    - » Tactical Control of Prioritization of Organic/Nonorganic Sensors Over a 5,000-Sq Km Area
    - » Critical Target Assessment "Tippers" Within Minutes for 10's of Mobile Critical Targets, Air Defense Targets, Stealth Platforms, BDA
    - » Real-time Fusion/Cross-Cueing of Organic Surveillance and Nonorganic Assets To Achieve High Precision
  - ***Direct Dissemination of Just-in-Time Mission Materials to and From the Warfighter***
    - » Distributed "Mission Folders" and "Target Folders" Accessible Via Tactical Internet Uplink and GBS Downlink
    - » High-Capacity Injection Uplinks From Primary Deployed Tactical Mission Support Centers, With Fully Interoperable Tactical Relay to Unit, Foot Soldier
  - ***Mission Materials Change Visualization and Preview by the Warfighter on-the-Move***
    - » Adaptive Pilot/Foot Soldier Decision Aids To Preview Target/Objective Area Changes With Minimal Distraction From Ongoing Tasks

Precision Information Direction

Goal

Enable the On-scene Commander to Exploit and Shape the Battlespace by Dynamically Directing and Integrating (in Accordance With Operation, Battle and Mission Priorities) Both Tactical and Supporting C4ISR Resources for Targeting, Weaponeering, Mission Preview, BDA, and Combat Assessment (To Facilitate the Application of Precision Weapons, Precision Forces, and Rapid Response)

Current Limitations

- Limited Response to Rapid Battlespace Changes; Rigid ISR, Lack of Visibility Into Sensor Tasking and Coverage
- Limited Ability To Keep Stressing Targets at Risk
- Limited Comprehensive Sensor Tracking and Sharing/Coupling of Operations To Support Campaign Missions
- No Just-in-Time Retargeting Capability
- Sortie Impact Limitations; Poor/Slow BDA

Critical New Functional Capabilities

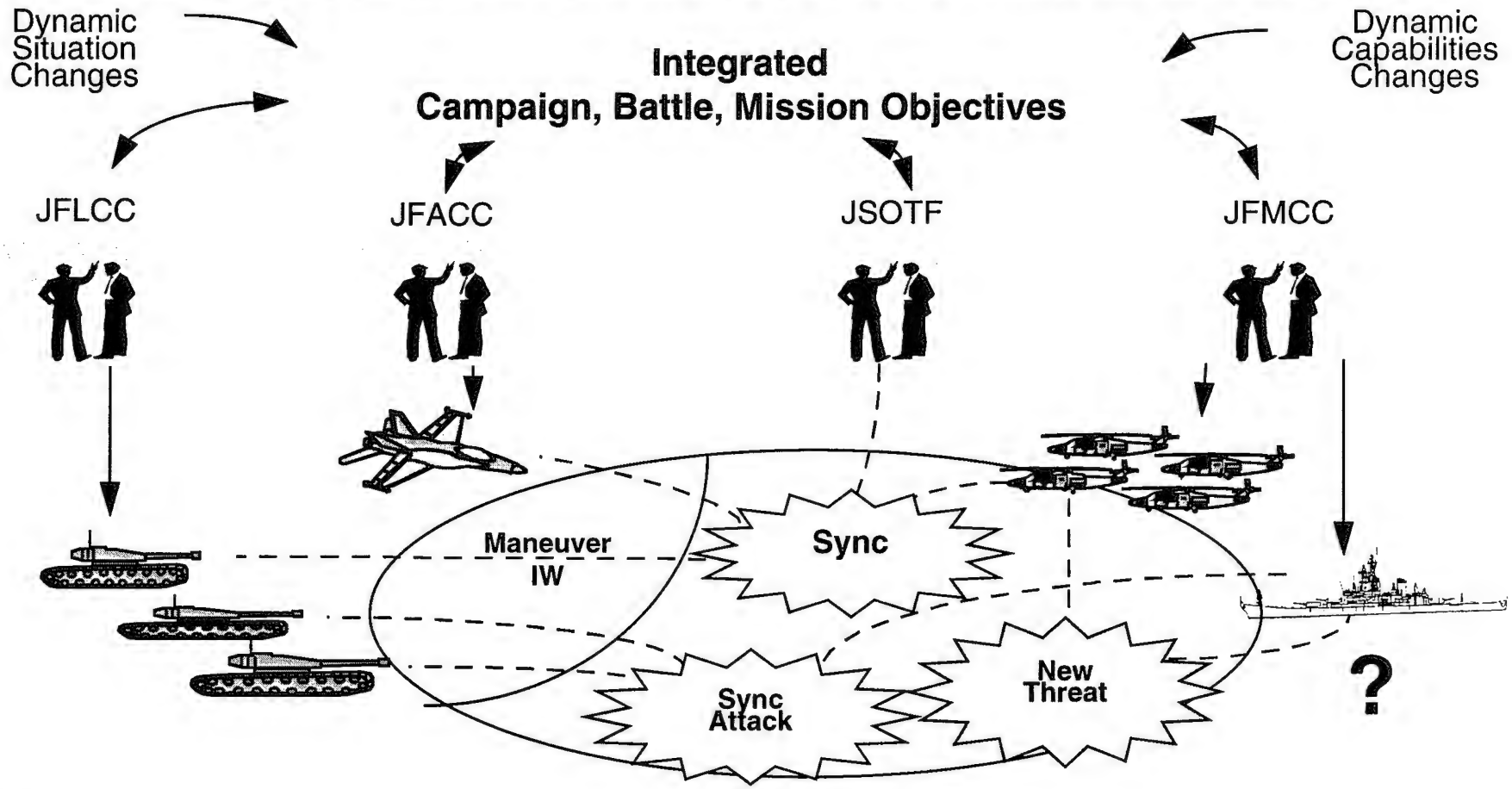
- National and Theater Intelligence Processing and Broadcast
- IW and Spectrum Dominance Monitoring, Planning, and Execution
- ISR and C3 System Management
  - Automated Aids
- Shared, Dynamic, Distributed, Continuous Collaborative Planning
- Collaborative Situation Assessment and BDA
- Rapid Accurate BDA
- Rapid Accurate Targeting
  - Just in Time
  - Dynamic Strategy Ties to ISR
- Mission Rehearsal/Embedded Training
- Command Projection

Needed Technology

- Rapid Modeling and Simulation
  - Sensor Coverage Analysis
  - Spectrum Dominance and IW
- Dynamic Execution Management
  - Virtual Workspaces
  - Intelligent Agents for C4ISR Tasking Plans
  - Sensor Fusion
- System of Systems Performance Optimization
  - Plug-and-Play Architecture
  - Improved Data and Uncertainty Visualization and Management
- ATR, BDA
- Virtual Anchor Desk
- Nodal Analysis

Integrated Force Management

Goal:
Dynamically Synchronizing Force Operations by Collaborative Execution Monitoring, Repair, and Retasking of Shared Assets Across Echelons, Missions, Components, and Coalition Forces *(Control of "Coherent" Joint/Simultaneous Operations to Optimize Dynamic Use of Resources Without Preempting "Initiative")*



Operational Concepts (Forces)

- Extended Battlespace Depth, Breadth, and Height With Fewer Forces (Empty Battlespace)
  - — More Dispersed Formations (Units, Key Nodes, Leaders)
  - — Fewer Operational Pauses—Condensed Time, i.e., Rapid Succession of Action With Little Pause
- Simultaneous Operations to Achieve Multiple Objectives Throughout Theater of Operations Produce Overwhelming, Decisive Combat Power
- Simultaneous Engagement by Variety of Joint Warfighting Systems
- Substitution of Situational Knowledge for More Traditional Physical Control Measures
- Dynamic Battlespace Management
  - — Capable of Adjusting Quickly to Temporal and Spatial Variations
  - — Rehearsal and Retasking Enroute and on-the-Move
- Near Real-Time Collaborative Tasking, Retasking, Mission Assessment, and Replanning
  - — Cross-Mission Tasking of Multimission Capable Assets
  - — Concurrent Mission Assessment
  - — Seamless Connection Between Battle Management and Sensor/Shooter (Mission Monitoring and Dynamic Deconfliction, Reactive Repair and Replanning)
- Information as Focus of Operations
  - — Protect Friendly Information Systems While Denying Enemy Use of His Systems

C2I Operational Concepts

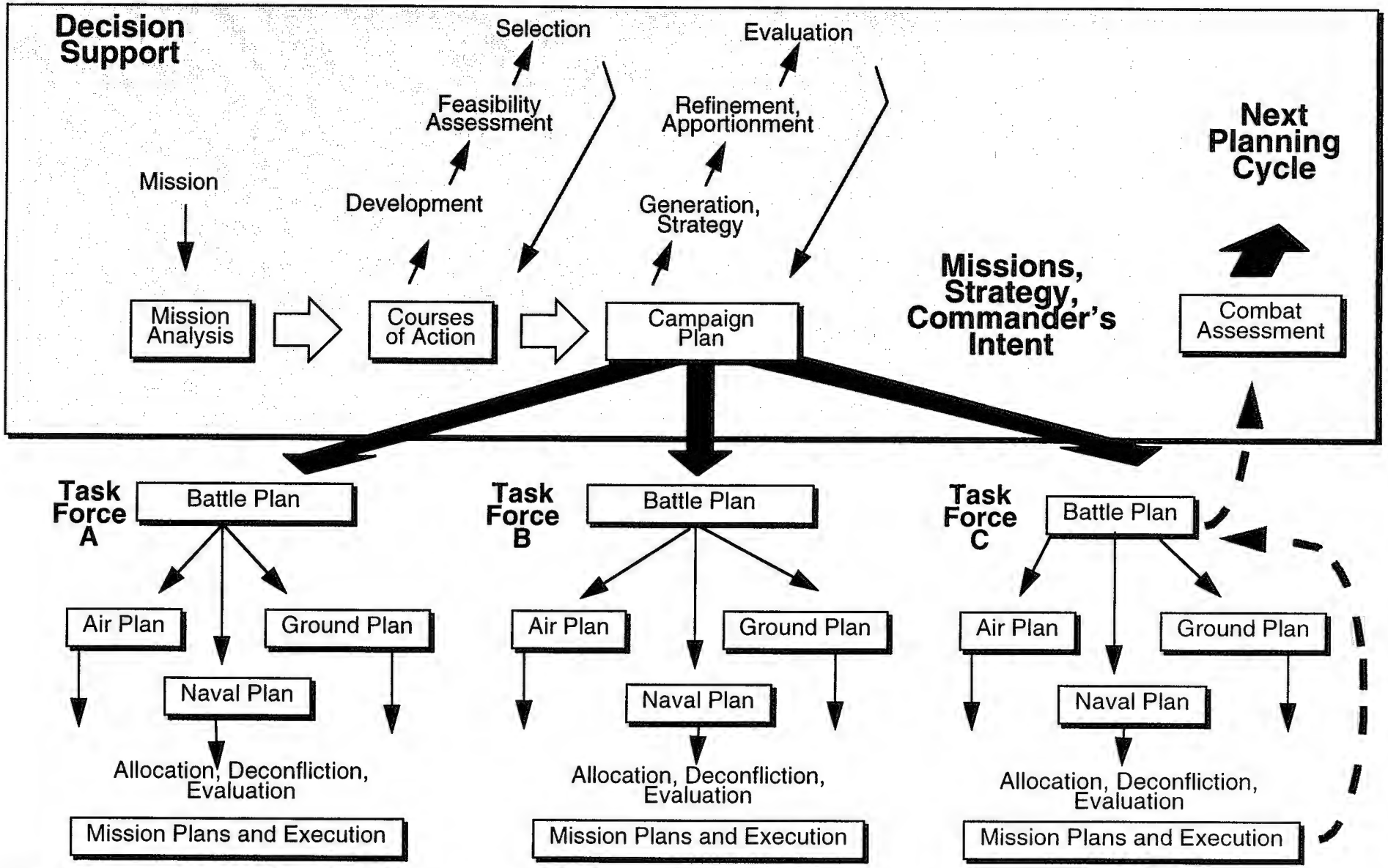
- Battle Command
  - — Horizontal Integration of Battlefield Functions
  - — Capable of Adjusting Quickly to Temporal/Spatial Variations
  - — Must Aid Commanders in Tailoring and Arranging Forces
- Force Coherence and Application of Combat Power Achieved Through Shared Knowledge of Battlefield Vice Traditional Controls
  - — Common Knowledge Holds Force Together
  - — Substitution of Situational Knowledge for More Traditional Physical Control
  - — Implies Changes in Dynamics of Leadership
- Continual Accurate and Timely Shared Perceptions of the Battlespace
  - — Nonhierarchical Dissemination of Intelligence, Targeting, and Other Data at All Levels
  - — Dynamic Battlespace Management

Collect Intel...Predict Opposing Force Behavior...Assess Enemy Behavior...Act Quickly

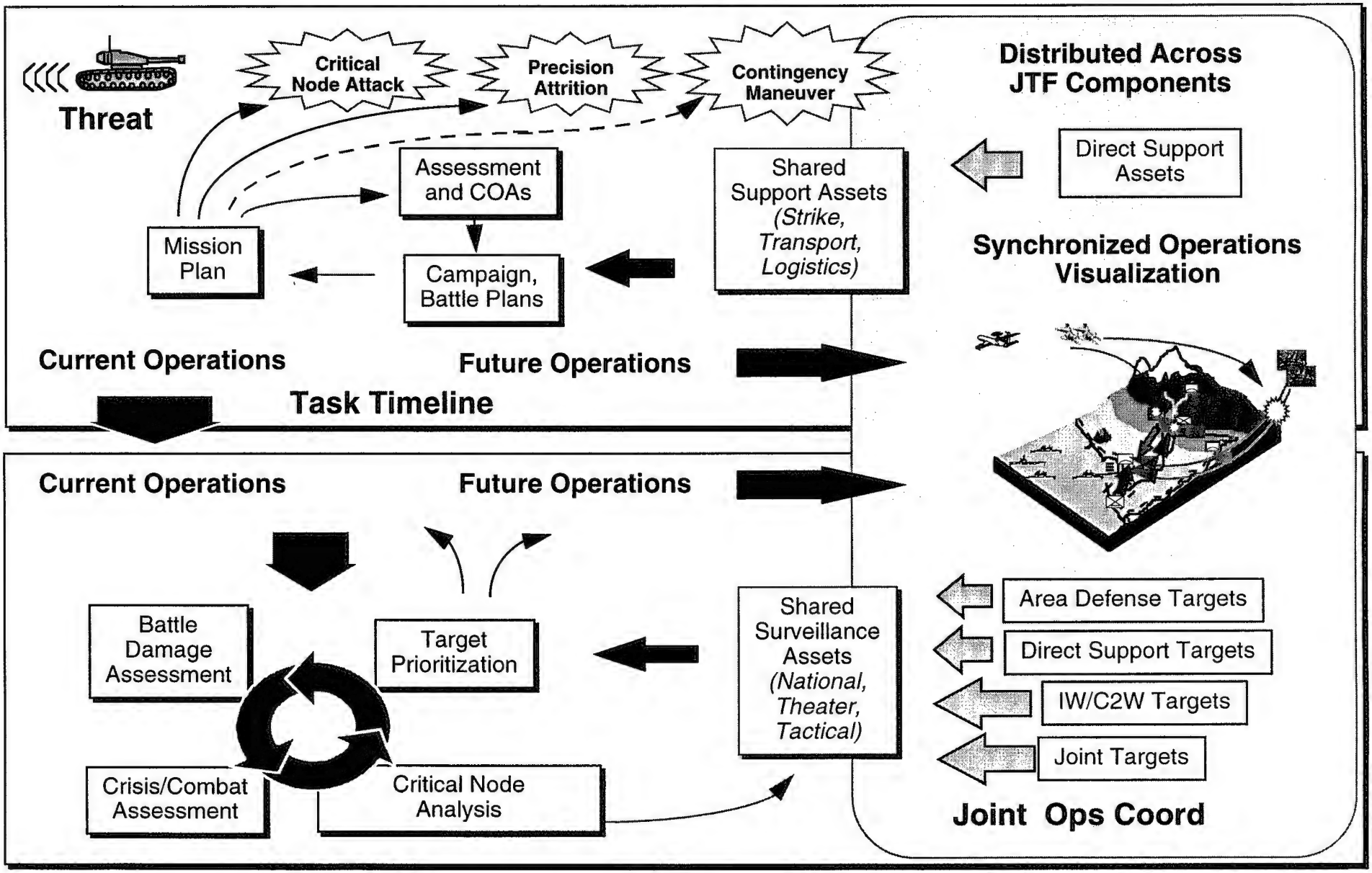
C2I Operational Concepts *(Continued)*

- Common View and Understanding of What Needs to Be Done (Strategy, Commander's Intent)
- Shared Real-Time Awareness of Force Disposition in the Battlespace Tailored to Requestor's Needs, Not Just Geographic
- Common, Relevant Picture of Battlespace Tailored to Needs of Individual Users
  - — Pull-Down Information on Demand
  - — Available to Deciders, Shooters, and Supporters
- Dynamic, Fast-Paced, Simultaneous, Collaborative Planning, Tasking, and Replanning
  - — Allocation of Assets to Objectives; Allocations of Weapon Systems to Target
  - — Coping Simultaneously and at Multiple Levels Concurrently
  - — Mission Execution Package Construction
  - — Recursive, Adaptive Planning Based on Mission Assessment and Prediction
  - — On-Line Monitoring of High-Value System Status During Simultaneous Attack Execution
  - — Continual Dynamic Reallocation of Shared Assets to the Highest Collaborators and Execution Level

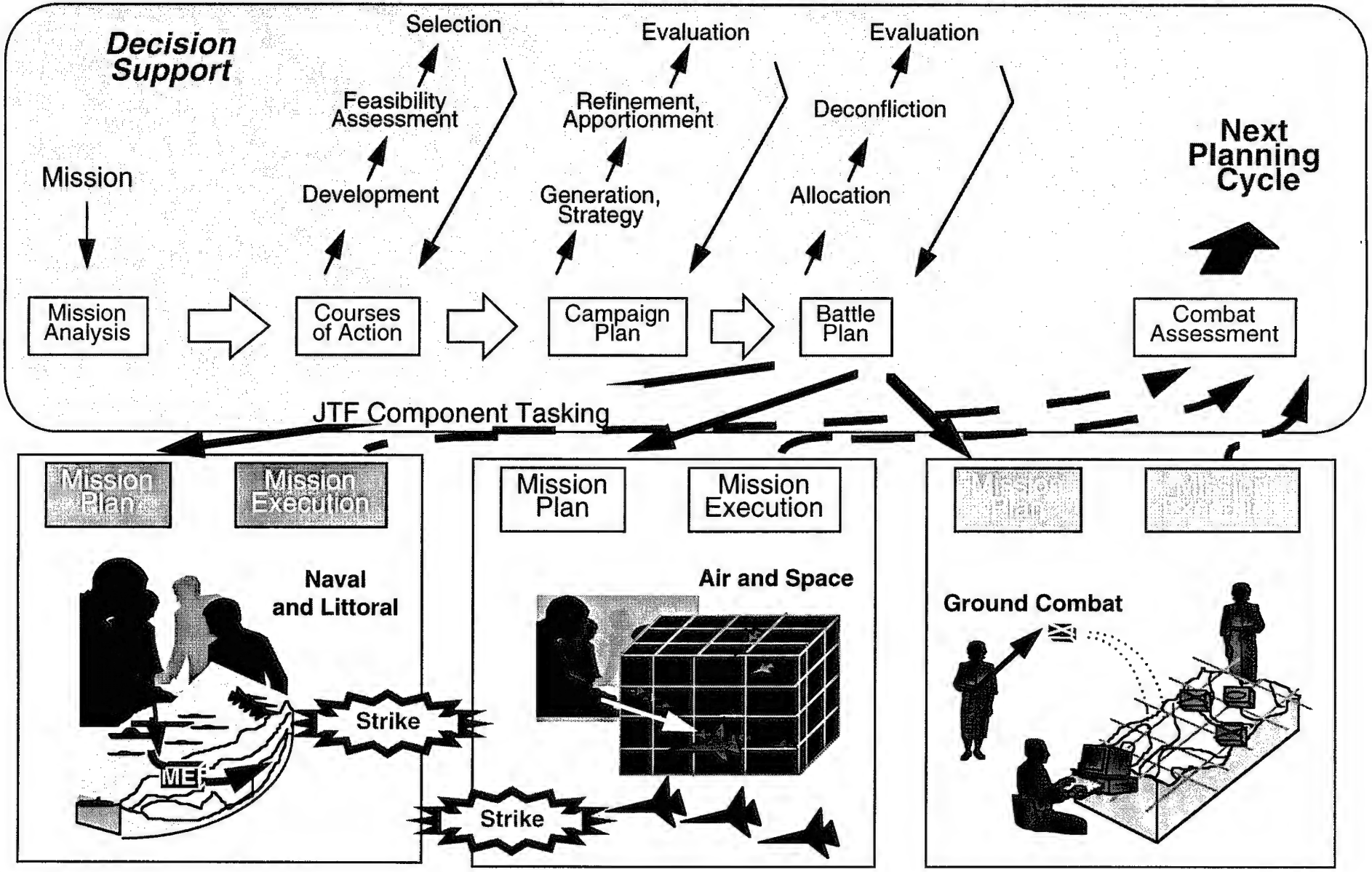
Simultaneous, Coordinated Operations—Current



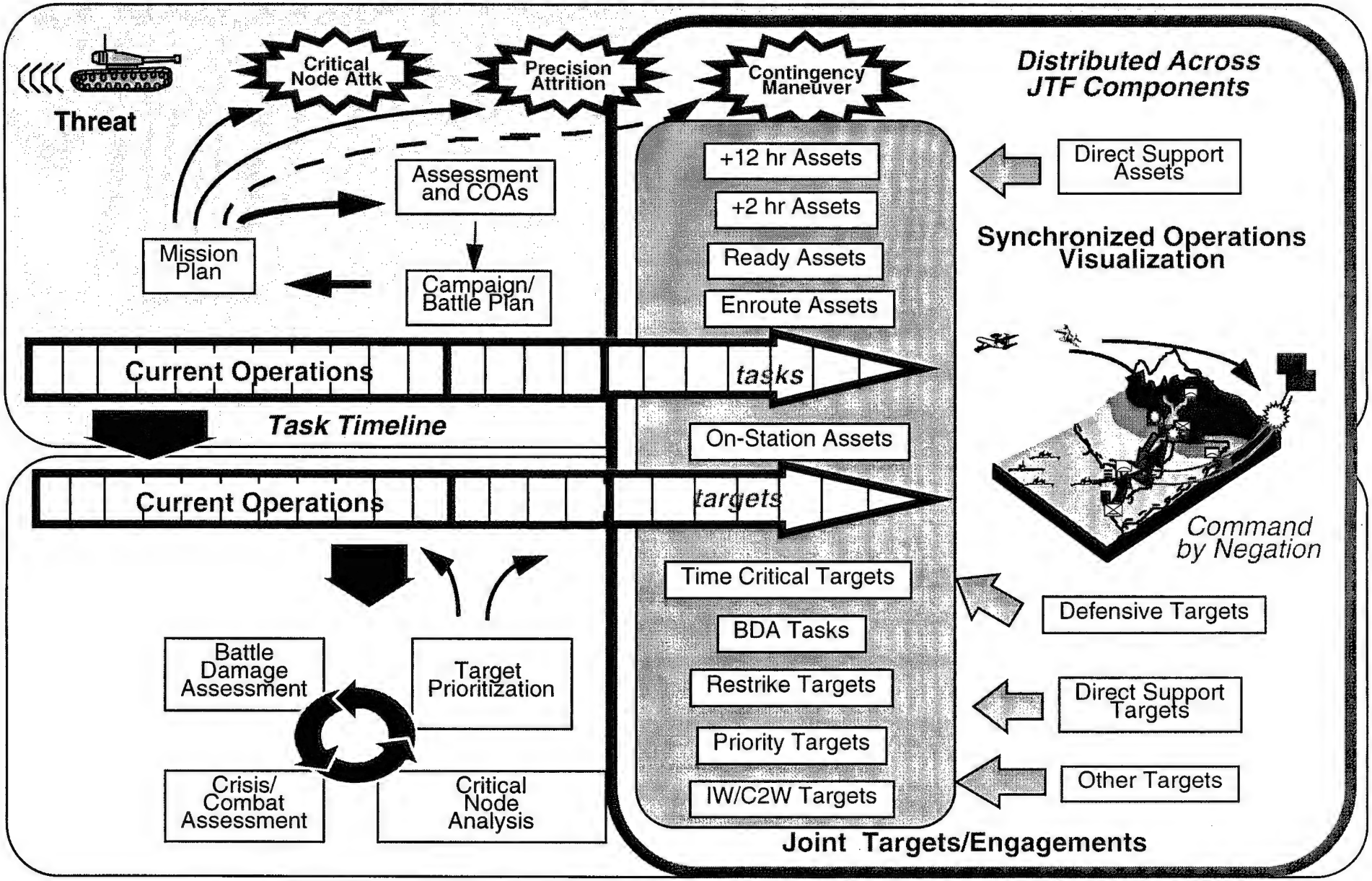
Simultaneous, Coordinated Operations—Reengineered



Synchronized Engagement—Current



Synchronized Engagement—Reengineered

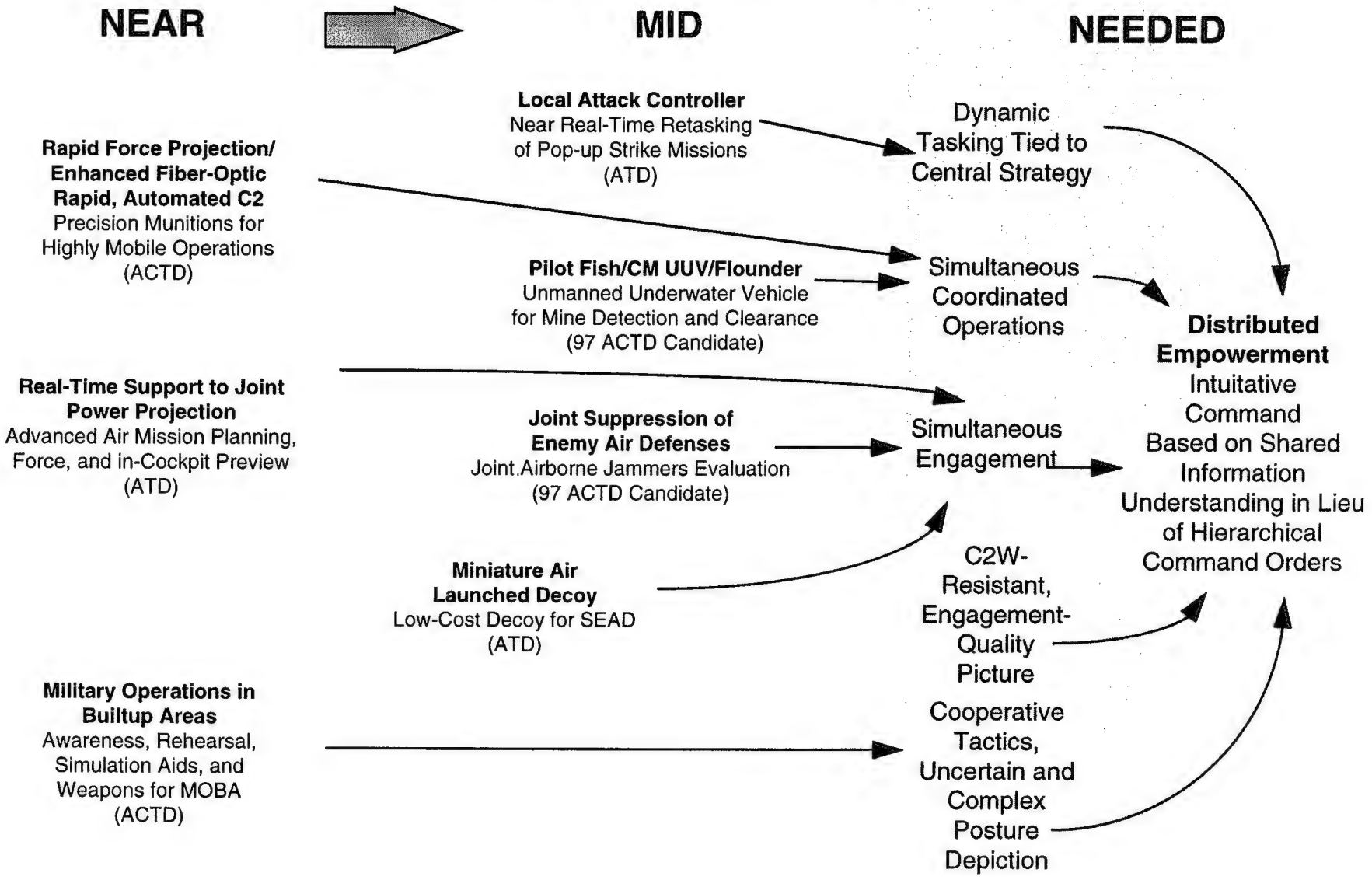


Current Limitations	Causes	Detailed Critical Functional Capabilities	Technology Challenges
Limited Common Understanding of Needed Changes and Relationship of Individual Tasks to Overall Campaign Objectives	No Mechanism To Disseminate and Comprehend Impact of Changes	Dynamic Tasking Tied to Central Strategy, and Commander's Intent and Task/Target/Time/Space Relationship to Strategy	Dynamic Shared Warplan, Multidimensional Data and Uncertainty Visualization
Limited Real-Time Insight Into Conduct of Operations	No Mechanism for Concurrent Assessment of Achievement of Objectives	Support to Simultaneous Coordinated Operations • Strategic Attack Priorities • Shared Asset Reallocation • Multimission Packages • Concurrent Assessment	Preserving Intuitive Command Style in Presence of Dynamic Reallocation of Shared Assets Multidimensional Reasoning on Support Constraints Cross-Misson Tasking to Multimission Force Packages Concurrent Mission/Operation/ Campaign Assessment
Coordination of Operations Through Rigid Framework of Battlefield Geometry	No Mechanism for Real-Time Resource Tasking, Coordination, and Deconfliction	Support to Simultaneous Engagement • Support Asset Coordination • Mission Monitoring • Dynamic Deconfliction • Repair and Replanning • Consumables Monitoring	Real-Time Mission/Task Monitoring, Repair, Retask Dynamic Scheduling/Coordination of Assets for Interdependent Tasks On-line Monitoring of Expenditure, Consumables
No Responsive Way To Dynamically Retask High-Value Assets Across Missions and Services in Response to Changing Situations, Opportunities	No Mechanism for Real-Time In-Transit Mission Rehearsal	Retasking and Rehearsal For Coordinated Operations Enroute and On-the-Move	Embedded Mission Preview, On-the-Move Broadcast Commission to Support 500-Node Distribution Rehearsal

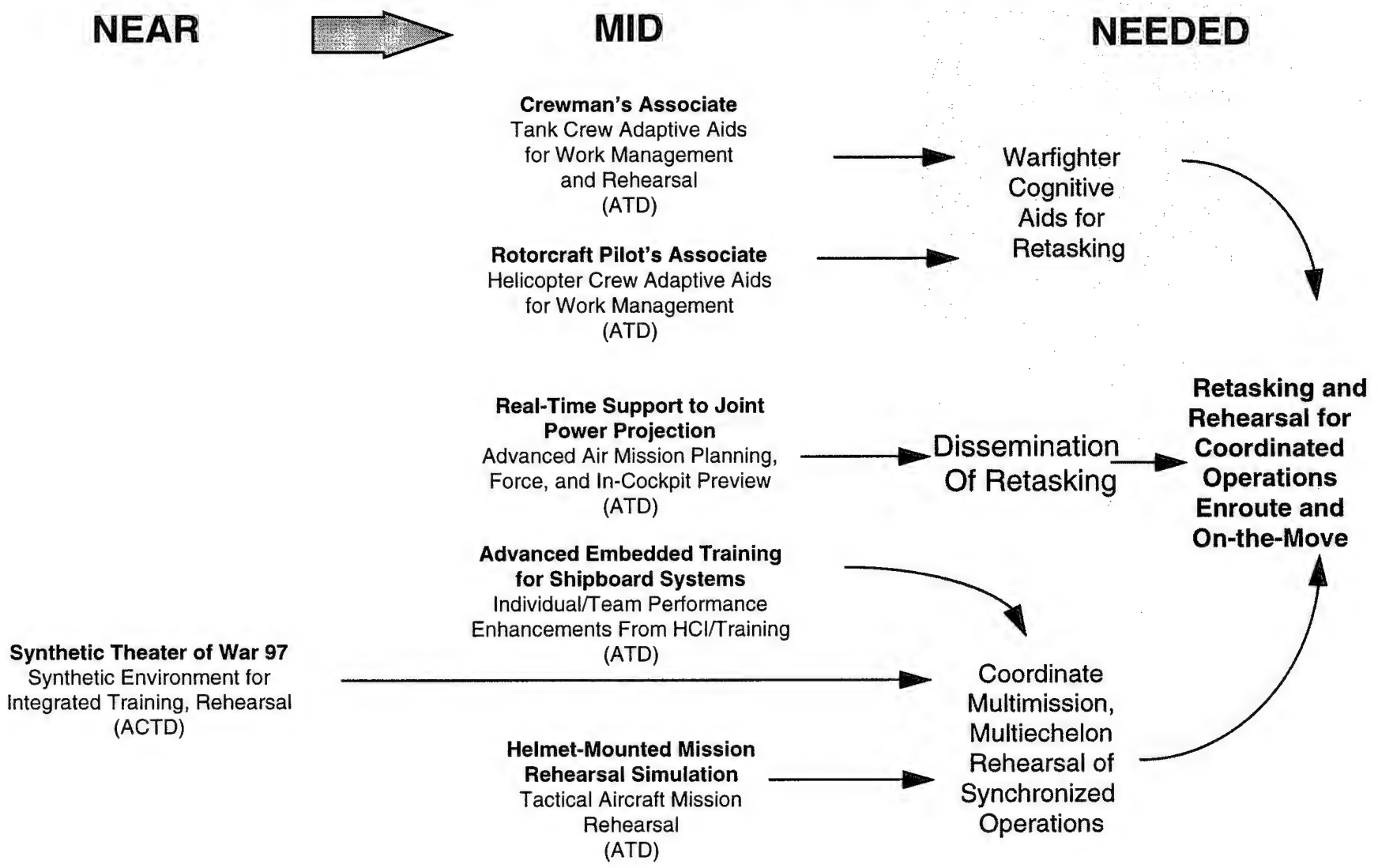
Detailed Critical Functional Capabilities Summary

- Continual and Dynamic Planning and Tasking, Always Tied to a *Central Strategy*
  - **Common View** of What Needs To Be Done *(Commander's Intent, End States, Task/Target/Time/ Space Relationships to Strategy)*
  - **Simultaneous Coordinated Operations:** Battle Management Support for Intuitive Command of Dedicated Assets *(Centralized Coordination, Distributed Execution)*
    - » Continual Collaborative Reallocation of Shared Assets *(Surveillance, Strike, Fire Support, Maneuver)* to the Strategic Attack of Highest Priority Objectives
    - » Cross-Mission Tasking, Multimission Capable Force Packages
    - » Concurrent Mission/Operation/Campaign Assessment
  - **Simultaneous Engagement:** Seamlessness Between Battle Management and Sensor/Shooter; Near Real-Time Cooperative Retasking
    - » Coordination of Assets for Supporting Fires, Supporting Tasks
    - » Real-Time Mission Monitoring and Dynamic Deconfliction
    - » Reactive Mission/Task Repair and Replanning
    - » On-line Monitoring of Systems Status and Consumables
- Retasking and Rehearsal for Coordinated Operations Enroute and On-the-Move

Current and Needed Operational Demonstrations



Current and Needed Operational Demonstrations *(Continued)*



Potential Metrics for Demonstration Areas

- **Dispersed/Distributed "Empowerment" Using Mission-Oriented, Higher Level Cognitive Understanding Across the Force (in the Presence of Imperfect or Deceptive Information)**
  - ***Dynamic Tasking Tied to Central Strategy***
    - » Distributed Real-Time Database Consistent With "Strategy-to-Task" Hierarchy of Predictive Battlespace Opportunity Planning
    - » Dynamic Database Updates to Critical Node Hierarchy and Strategic Attack Priorities
    - » Continuous, Distributed Posting and Deconfliction of Task/Target/Time/Space/Spectrum Allocations
    - » Concurrent Assessment of Task Progress
  - ***Support to 10's of Simultaneous Coordinated Operations***
    - » Distributed Real-Time Database To Update 5,000 Task-to-Task Dependencies, Assumptions, and Temporal/Geographic/Resource Constraints; Involving 100's of Participating Units
    - » Dynamic, Distributed Reallocation of Shared and Excess Assets (Aircraft Sorties, Surveillance, Weapons, C3, and Processing) to Most Critical Tasks and Targets in Accordance With Central Strategy
    - » Automated, Distributed Coordination of Supporting Tasks (e.g., Massed Fire Support) and Allocation of Multimission-Capable Assets

Potential Metrics for Demonstration Areas *(Continued)*

- **Dispersed/Distributed Empowerment Using Mission-Oriented, Higher Level Cognitive Understanding Across the Force (in the Presence of Imperfect or Deceptive Information)** ***(Continued)***
  - — ***Support to Real-time, Simultaneous Engagement Involving 10's of Units/Event (Can Have Several Concurrent Events)***
    - » Automated, Collaborative Route Optimization
    - » Time on Target and Support Mission/BDA Scheduling
    - » Mission Coordination Information Generation
    - » BDA Analysis and Reattack
    - » Plan Repair, Consumables Monitoring, and Retasking of Excess Mission Assets

- **Intelligent, Distributed Automated Rules of Engagement Management for Joint Force Integrated Offense, Defense, and Survivability**
  - — ***Integrated Offensive and Defensive Rules of Engagement To Support Diversion of Offensive Assets to Time-Critical Defensive Tasks or To Disperse for Signature Reduction/Survivability***

Potential Metrics for Demonstration Areas *(Continued)*

- **Retasking and Rehearsal for Coordinated Operations Enroute and on-the-Move**
  - ***Dissemination of Enroute Coordinated Task Changes to 10's of Units in Minutes***
    - » Retargeting/Weaponeering Information and Mission Folders
    - » Mission Route, Timing, and Coordination Information
    - » Dissemination and Preview of Alternative Targets, Contingency Threat Sets, and Contingency Tasks
    - » Dissemination and Preview of Countermeasures Options, Response Libraries, and Effects
    - » Mission Preview
  - ***Coordinated Multimission, Multiechelon Rehearsal of Coordinated Operations and Simultaneous Engagements (10's)***
    - » Force-to-Force Combat Task and Logistics Simulation
    - » Synchronized Sensor-to-Shooter-to-Shooter Walkthrough
    - » Constructive, Simulated Threats and "Virtual Own Force Presence"; Simulated IW/C2W; Tactical or Rear Echelon "Red Team" Anchor Desk
    - » Mission Critique

Integrated Force Management

Goal

Dynamically Synchronize Force Operations by Collaborative Execution Monitoring, Repair, and Retasking of Shared Assets Across Echelons, Missions, Components, and Coalition Forces (Control of Coherent Joint/Simultaneous Operations To Optimize Dynamic Use of Resources Without Preempting Initiative)
Adaptive Coordinated Defense—Integrate Defensive Systems Across Services Into a Collaborative Capability That Exploits Real-Time Retasking to Optimize Resources and Still Take Advantage of Distributed Empowerment

Critical New Functional Capabilities

- Mission Rehearsal and Embedded Training
- Command Projection
- Support Simultaneous Engagement and Coordinated Operations: OTH, Force Allocation, and Forcewide Hard/Soft Target Engagement Coordination
- Dynamic Tasking Tied to Central Strategy Throughout the Joint Force
- Repair and Consumables Management
- Joint Force Automated ROE
- Rapid, Accurate Targeting
  - –Integrated Air Defense, Strike, and C2W
- Rapid, Accurate Battle Damage Assessment
- Force Status and Execution Following
  - –Close Coordination, Detection, ID
- Shared, Distributed, Continuous Collaborative Planning
- IW and Spectrum Dominance Monitoring, Planning, and Execution

Current Limitations

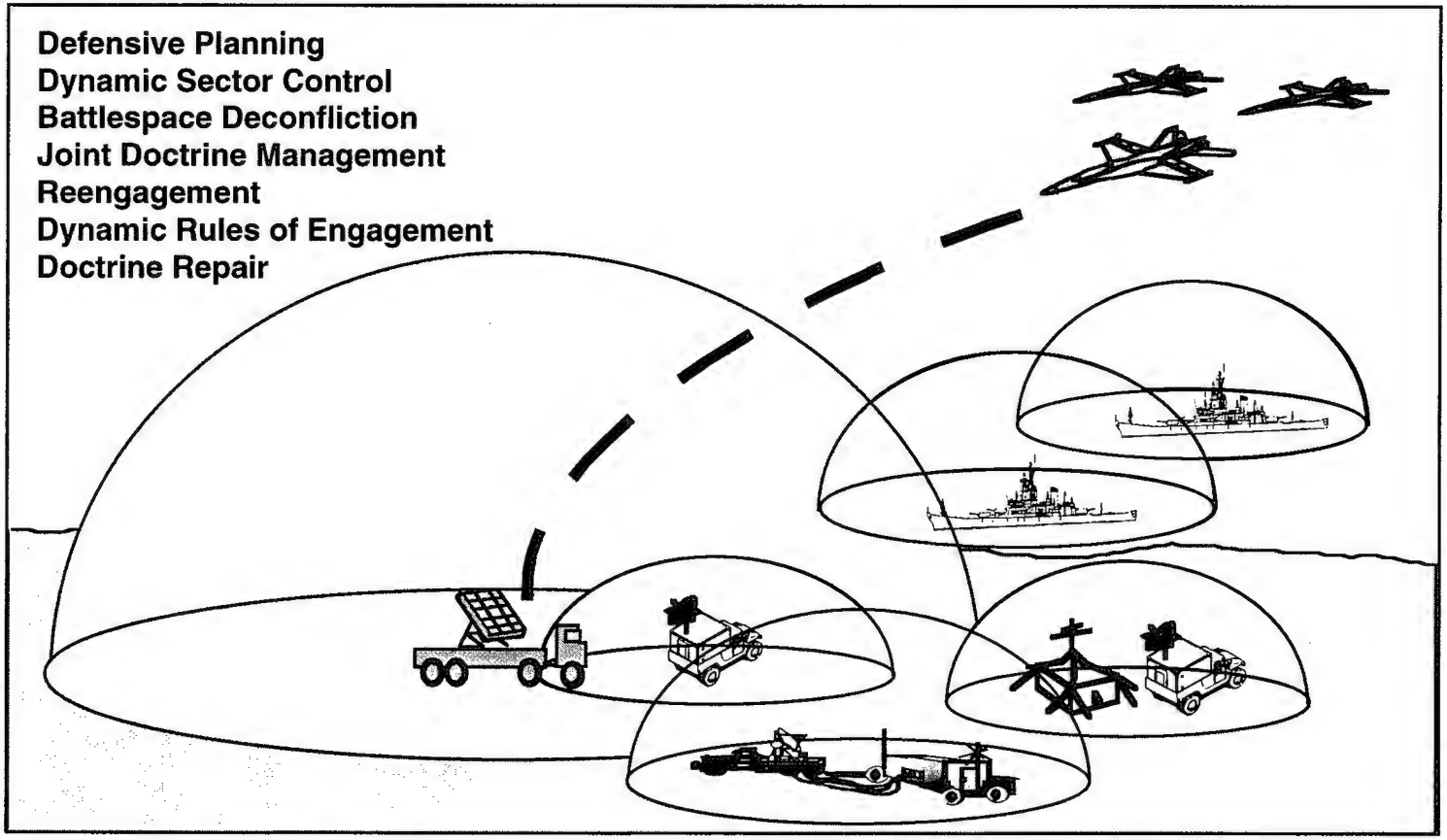
- Limited Common Situation Understanding and Perceiving What Needs To Be Done (Strategy, Commander's Intent) and the Relationship of Individual Tasks to Overall Campaign Objectives
- Limited Real-Time Insight Into Plan Execution
- Present Coordination Via Rigid Framework of Battlefield Geometry
- No Responsive Way to Dynamically Retask High-Value Assets Across Missions and Services in Response to Changing Situations, Opportunities
- Inadequate Ability To Translate Data Into Full Situation Understanding
- Limited Ability To Apply All Assets to Formulate and Support Coherent Defense
- Planning Is Manually Intensive

Needed Technology

- Continuous Dynamic Planning/Scheduling
- System of System Optimization and Management
  - Distributed, Collaborative, Virtual Work Spaces
  - Sensor Information Fusion
  - Anchor Desks
    - » Nodal Analysis
    - » ATR, BDA
- Cognitive Support
  - Data and Uncertainty Visualization and Management
  - Speech and Text Understanding
- Rapid M&S, Including C3I

Adaptive Coordinated Defense

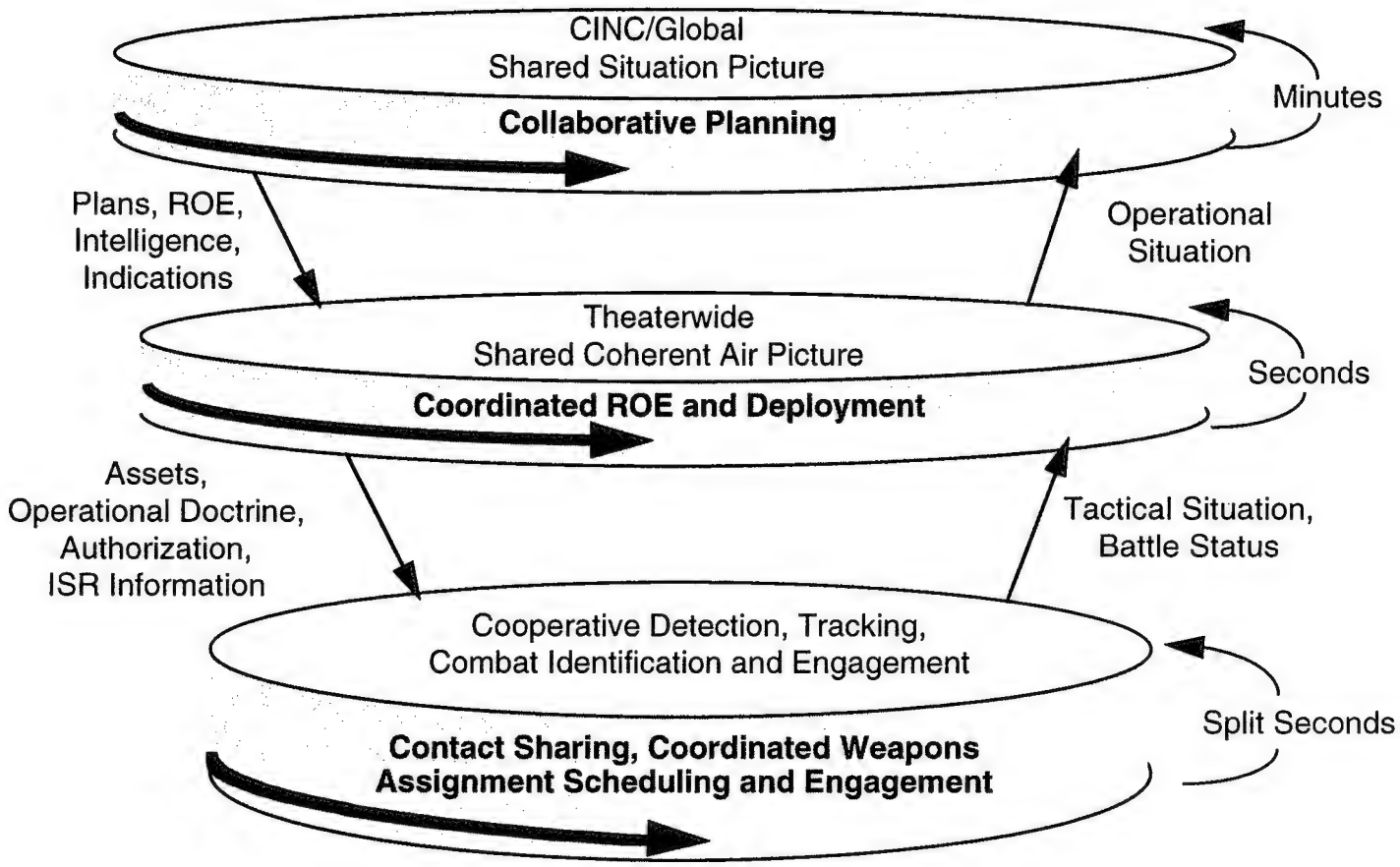
Goal:
Integrate Defensive Systems Across Services Into a Collaborative Capability That Exploits Real-Time Retasking to Optimize Resources and Coverage While Still Taking Advantage of Distributed Empowerment



Definition—Bounding the Subject

- Defense Against Flying Objects
  - — Against Threats That Include Cruise Missiles, Ballistic Missiles, Manned Missile-Launch Aircraft, Antipersonnel Aircraft and Helos, Airborne Surveillance and Command Units, Airborne Jammers, Remotely Piloted Vehicles (RPVs) and So on.
  - — Protection of Troops, Ships, Strategic and Tactical Assets, Population
  - — Using Defenses That Include Manned Interceptors, Missiles, ECM Deception and Other C2W Techniques, Likely New Detect and Kill Mechanisms, Calls for Preemptive Strike Against Enemy Air Assets and Support
- Focus on Improved Warfighting Performance Achievable Through Coordination and Close Cooperation

Operational Vision



Operational Concepts (Forces)

- Forcewide Coordination of Scheduling, Placement, and Tasking of Detection and Engagement Assets
- Forcewide, Coherent, Mutually Supporting Defensive Doctrine
- Attrition/Mitigation of Air Threat Through Prelaunch Preemptive Attack
  - — Integration of Air Defense and Strike Planning
  - — Integration of Air Defense and C2W
- Shared, Coherent, Complete Air Picture
- Shared, Positive Precise Position Reporting by Friendly and Noncombatant Air Traffic
- Application of All-Source Information to Enemy Identification Problem
- Protection of the Air Picture From Enemy Corruption
- Forcewide Coordination of Active (Hard and Soft) and Passive Defensive Measures
- Diversion/Reallocation of Assets in Reaction to Evolving Threat
- Closely Coordinated Detection, Tracking, and Identification Among Mutually Supporting Units
- Extension of Battle Horizon and Increased Depth of Fire Through Detection Sharing and Cooperative Engagement Modes
  - — Forward Pass, Over-the Horizon Cruise Missile Defense, Remote Data Engage, Remote Magazine Launch

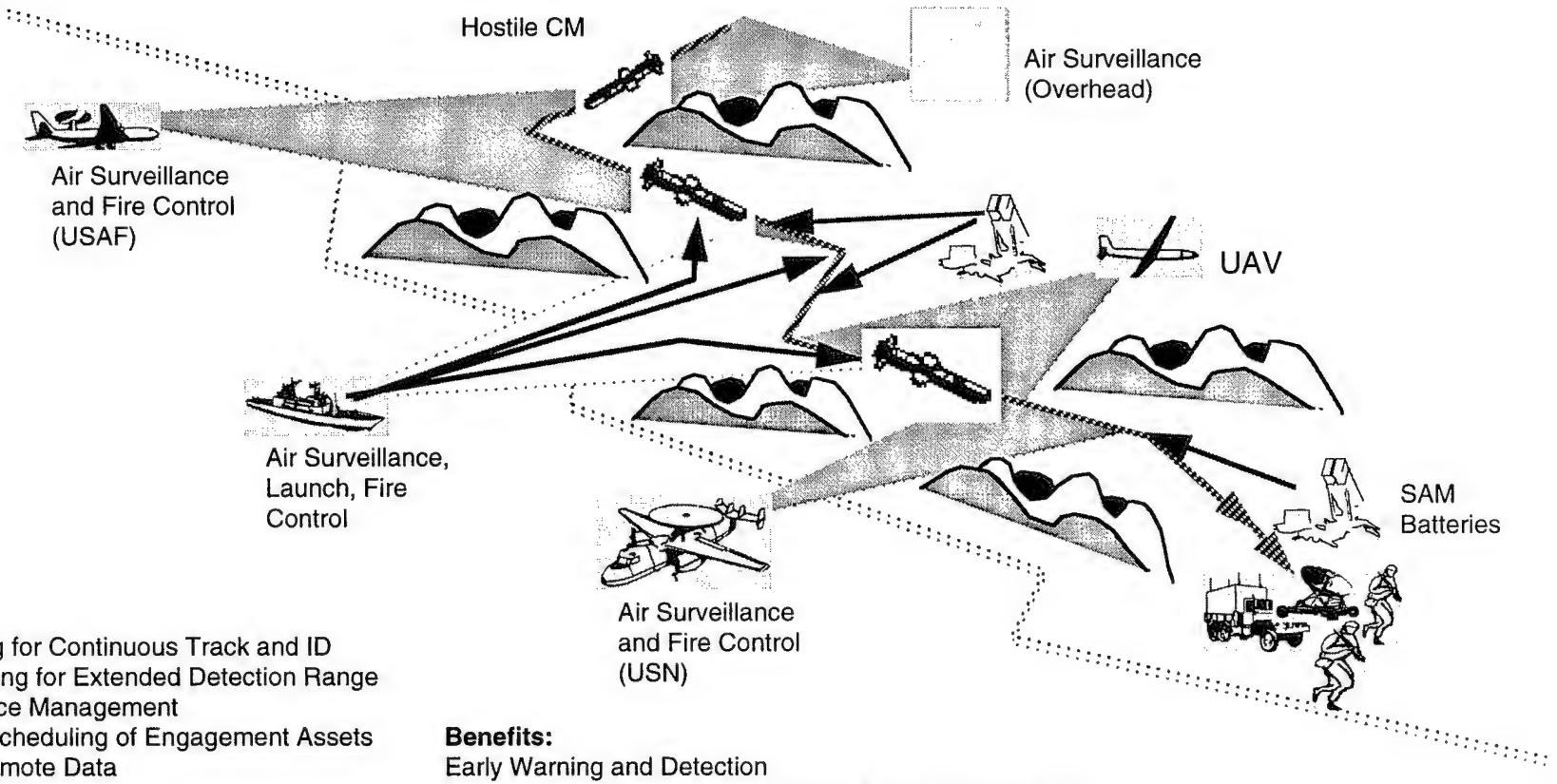
C2I Operational Concepts

- Integrated Planning
  - — Cross-Mission, Cross-Echelon, Collaborative
  - — Integrating of Plan Into Tactical Picture
  - — Reactive ROE Modification
- Intuitive Visualization
  - — Real-Time Picture, Environment, and Less Certain Indicators *(What Do We Know Now?)*
  - — Exposure *(What Does the Enemy Probably Know About Us?)*
  - — Detection Posture *(What Threats Could We See, and Where?)*
  - — Defensive Posture *(What Threats Could We Shoot, and Where?)*
- Centralized Coordination/Distributed Execution
  - — Forcewide Automated Threat Assessment/Weapon Assignment
  - — Automated Control-by-Negation
  - — Preemptive Asset Retasking
- Air Situation Picture Traffic Flowrate Control

Long-Range, Active/Passive Defense-Indepth—Reengineered

Situation: Overland Cruise Missile Attack on Land-Based Friendly Forces, in Mountainous Terrain

Illustrative Example



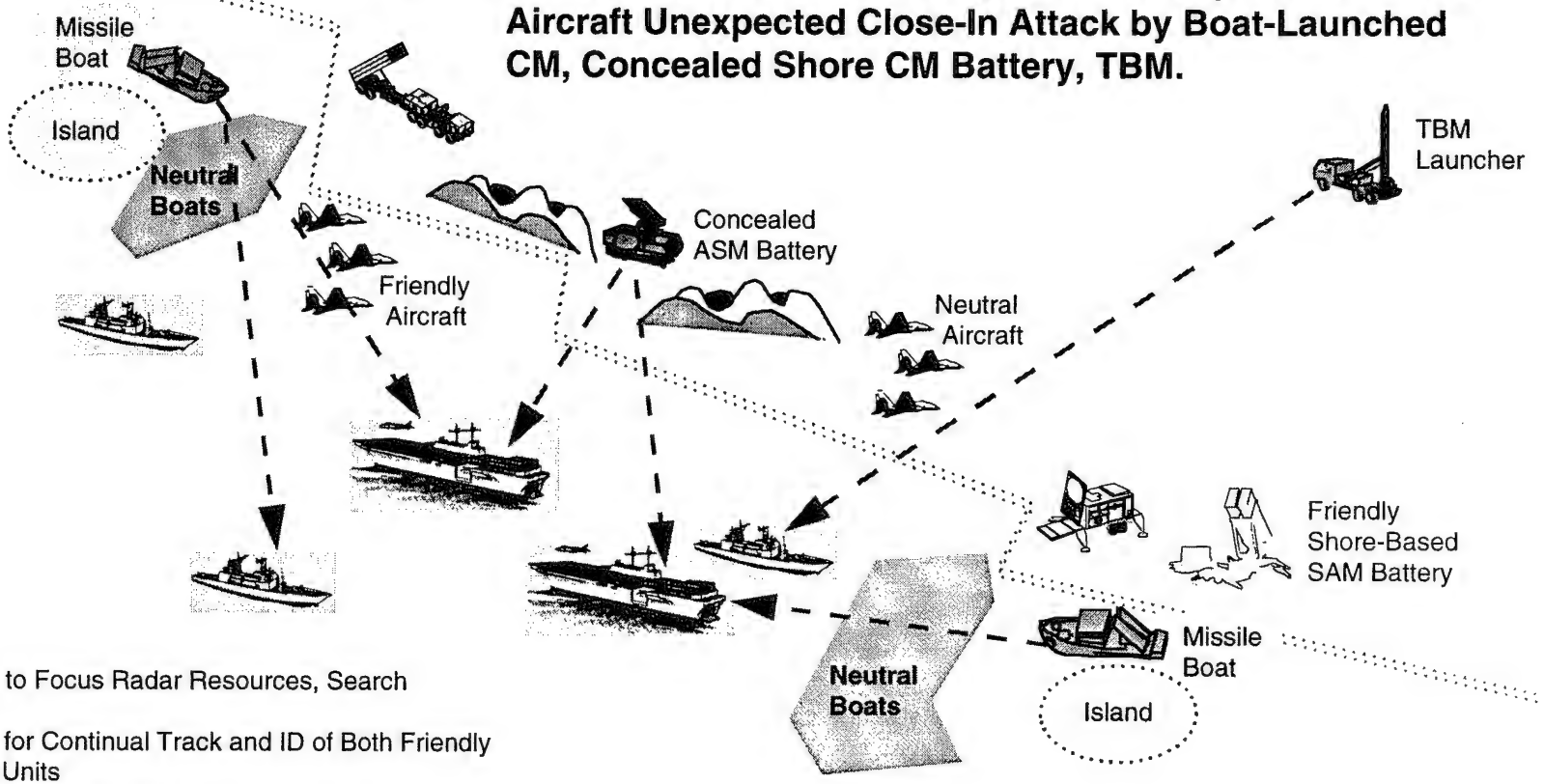
Strategy:
Sensor Netting for Continuous Track and ID
Precision Cueing for Extended Detection Range
Radar Resource Management
Coordinated Scheduling of Engagement Assets
Engage on Remote Data
Remote Launch Engagement
Forward Pass Engagement

Benefits:
Early Warning and Detection
More Intercept Opportunities/Depth of Fire (Perhaps 10:1)
Ability To Optimize Engagement Sequence, End-Game Geometry

Close-In, Pop-Up Threat—Reengineered

Illustrative Example

Situation: Offshore Operations in Support of Friendly Nation Situation Cluttered by Neutral/Suspect Boats and Aircraft Unexpected Close-In Attack by Boat-Launched CM, Concealed Shore CM Battery, TBM.



Strategy:

Integrated I&W to Focus Radar Resources, Search Sectors

Sensor Netting for Continual Track and ID of Both Friendly and Neutral Units

Precision Cueing for Extended Detection Range

Sensor Deployment To Avoid Terrain Masking

Continuous Reporting of Position and ID by Friendly and Cooperating Neutral Units

Automated Threat Reaction Doctrine Coordinated Across Joint Force Units

Benefits:

Battlefield Preparation

Ability to React; Mutual Support

Exploitation of All Defensive Assets

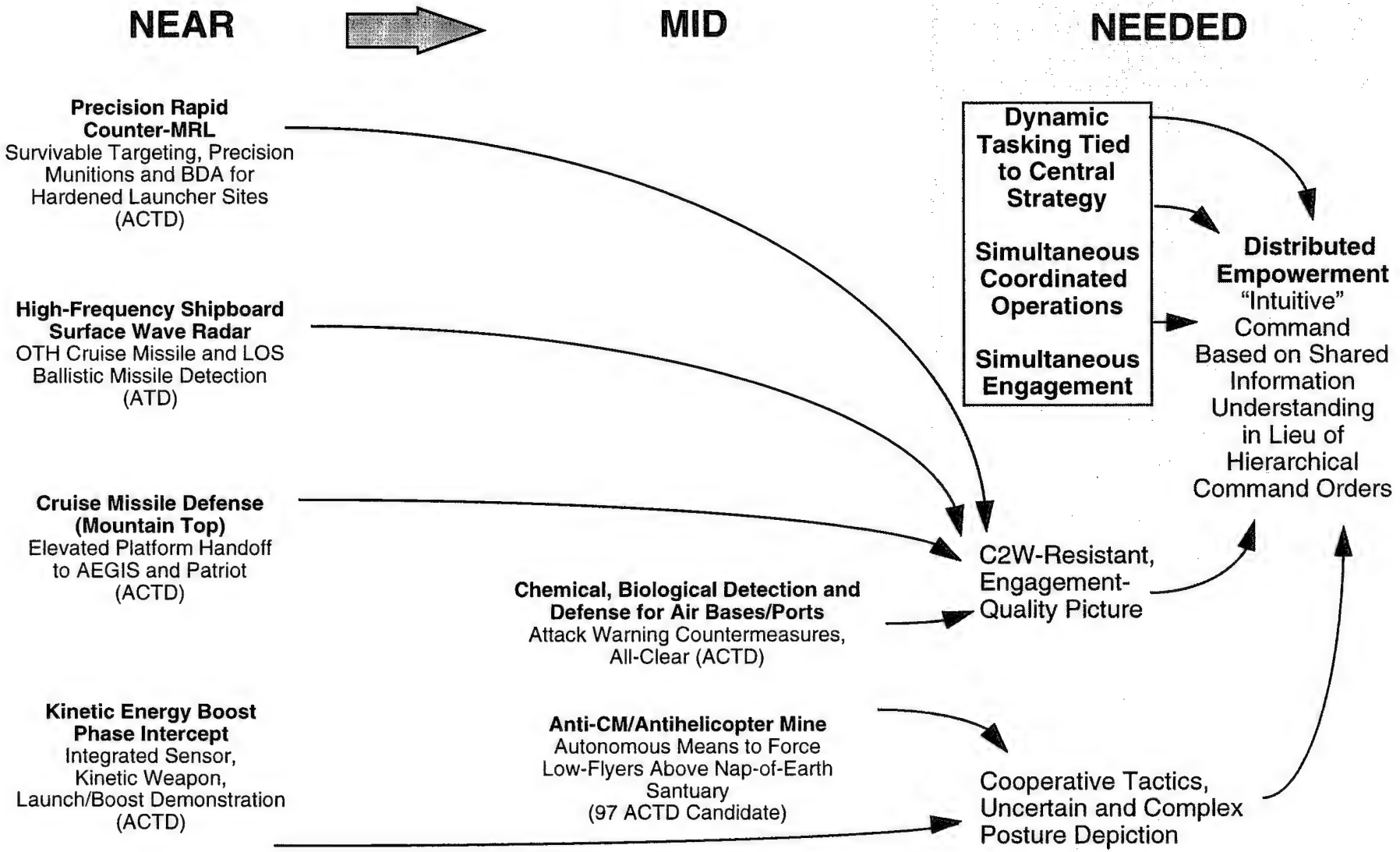
Safety of Friends and Neutrals

Current Limitations	Causes	Detailed Critical Functional Capabilities	Technology Challenges
Inadequate Ability To Translate Data Into Full Situation Understanding	Limits to Human Reactions, Capacity Under Stress	Precise Position Reporting, and Close Coordination of Detection, ID, Tracking, Among Units	Visualizing Complex and Fastmoving Situation, Posture, Exposure, ROE, and Response Options
	Limited Threat Reaction Time		
	Limited Automation of Reaction		Joint Composite ID
	Vulnerability to Countermeasures		
	Inability to Apply Complex ROEs	Dynamic Joint Force Automated Rules of Engagement	Distributed, Intelligent, Cooperative Rules of Engagement
Inability To Apply All Assets to Formulation of Shared Coherent Defensive Air Picture	Inadequate Knowledge of Combined Detect-Engage Capabilities Throughout Battlespace	Forcewide Coordination of Schedule, Placement, Tasking, Retasking of Detection/Engagement Assets	Visualization of Joint Capability Grids and Tasking
		Integrated Air Defense, Strike, and C2W to Attack, Threats Prior to Lauch	Rapid, Coordinated Response From On-Station Assets
	Limited Ability To Apply/Allocate Multiservice Assets in Shared Battlespace	Forcewide Hard/Soft Engagement Coordination and Passive Tactics (Dispersion, Deception)	Simulation of Countermeasures Effects, and Signature Reduction
	Inadequate Support for Deceptive, Dispersive Tactics	Over-the-Horizon Engagement Coordination (Extension of Battle Horizon and Increased Depth of Fire Through Detection Sharing and Cooperative Engagement, Forward Pass)	Real-Time Linking of Engagement Coordinated Information Across Force

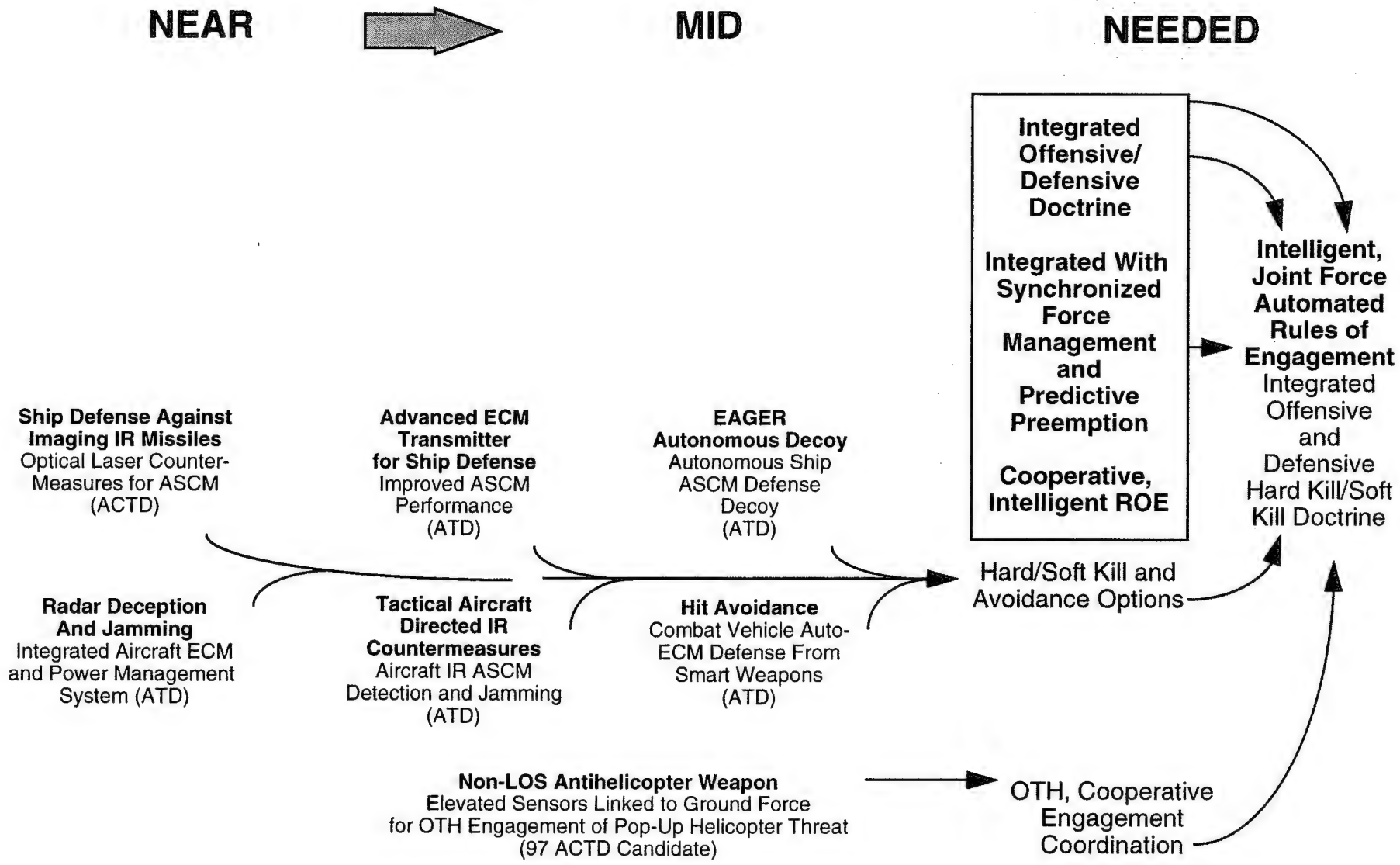
Detailed Critical Functional Capabilities Summary

- Precise Position Reporting, C2W-Resistance, and Close Coordination of Detection, ID, and Tracking Among Units
- Joint Force Automated Rules of Engagement
- Integrated Air Defense, Strike, and C2W to Attack Threats Prior to Launch
- Forcewide Hard/Soft/Passive Engagement Coordination
- Over-the-Horizon Engagement Coordination
- Real-Time Sensor Data Exchange for Forcewide Coordination of Scheduling, Placement, and Tasking

Current and Needed Operational Demonstrations



Current and Needed Operational Demonstrations *(Continued)*



Potential Metrics for Demonstration Areas

- **Dispersed/Distributed Empowerment Using Mission-Oriented, Higher Level Cognitive Understanding Across the Force (in the Presence of Imperfect or Deceptive Information)**
  - ***Real-Time, C2W-Resistant Forcewide Tactical Depiction of Detection, ID, and Tracking of 100's of Threats at 2 Updates/Second***
    - » Joint, Composite ID Capability and Uncertainty Built Into Picture
    - » Dwell-by-Dwell Integration of Joint-Force Sensors for Continuous Tracking and Characterization of Difficult Targets in Difficult Environments
    - » 4D Visualization of Complex and Fast Moving Situation, Posture, Exposure, ROEs, and Response Options
  - ***Forcewide Coordination and Visualization of Scheduling, Placement, Tasking, Retasking of Detection, and Engagement Assets***
- **Theaterwide Joint Information Warfare and Spectrum Dominance**
  - ***Real-Time Integration/Cross-Cueing Between Defense, Offense (Integrated Force Management), and C2W (Predictive Planning and Preemption) to Attack Threats Prior to Launch***
    - » 5-Minute Response Time To Determine and Assess Offensive/C2W Response to Detected Threat by Enroute/On-Station Assets

Potential Metrics for Demonstration Areas *(Continued)*

- **Intelligent, Distributed, Cooperative, Automated Rules of Engagement Management for Joint Force Integrated Offense, Defense, and Survivability**
  - ***Distributed, Cooperative ROE Generation Intelligent Enough To Provide "Legal"-Quality Cues for Rules of Engagement on Evasive and Deceptive Tracks***
    - » Checklist of ROE Options, Deferral of Response Decision as Long as Practical
    - » Recognizing Enemy Cooperative Tactics and Similar Patterns
    - » Automated Provision for Managing Uncertainty
  - ***Integrate Soft Kill and Avoidance Into Automated Response Recommendations***
    - » Determine and Rank C2W, Signature/Spectrum Management, Dispersion Options Within 1 Minute
    - » Simulate Countermeasures Effects and Signature Reduction in 2 Minutes With Medium Confidence, 5 Minutes With High Confidence
    - » Develop and Disseminate Automated Unit Tasking in Seconds Following Option Selection

Potential Metrics for Demonstration Areas *(Continued)*

- **Intelligent, Distributed, Automated ROE Management for Joint Force Integrated Offense, Defense, and Survivability**
  - — ***Over-the-Horizon Engagement Coordination (Extending Battle Horizon and Depth of Fire)***
    - » Detection Sharing on a Contact-by-Contact Basis
    - » Real-Time Linking of Contact Engagement and Engageability Information Across the Force
    - » Cooperative Engagement and Forward Pass

Adaptive Coordinated Defense

Goal

Dynamically Synchronize Force Operations by Collaborative Execution Monitoring, Repair, and Retasking of Shared Assets Across Echelons, Missions, Components, and Coalition Forces (Control of Coherent Joint/Simultaneous Operations To Optimize Dynamic Use of Resources Without Preempting Initiative)

Adaptive Coordinated Defense—Integrate Defensive Systems Across Services Into a Collaborative Capability That Exploits Real-time Retasking To Optimize Resources and Still Maximize Distributed Empowerment

Current Limitations

- Limited Common Situation Understanding and Perceiving What Needs to Be Done (Strategy, Commander's Intent) and the Relationship of Individual Tasks to Overall Campaign Objectives
- Limited Real-Time Insight Into Plan Execution
- Present Coordination Via Rigid Framework of Battlefield Geometry
- No Responsive Way To Dynamically Retask High-Value Assets Across Missions and Services in Response to Changing Situations, Opportunities
- Inadequate Ability To Translate Data Into Full Situation Understanding
- Limited Ability To Apply All Assets To Formulate and Support Coherent Defense
- Planning Is Manually Intensive

Critical New Functional Capabilities

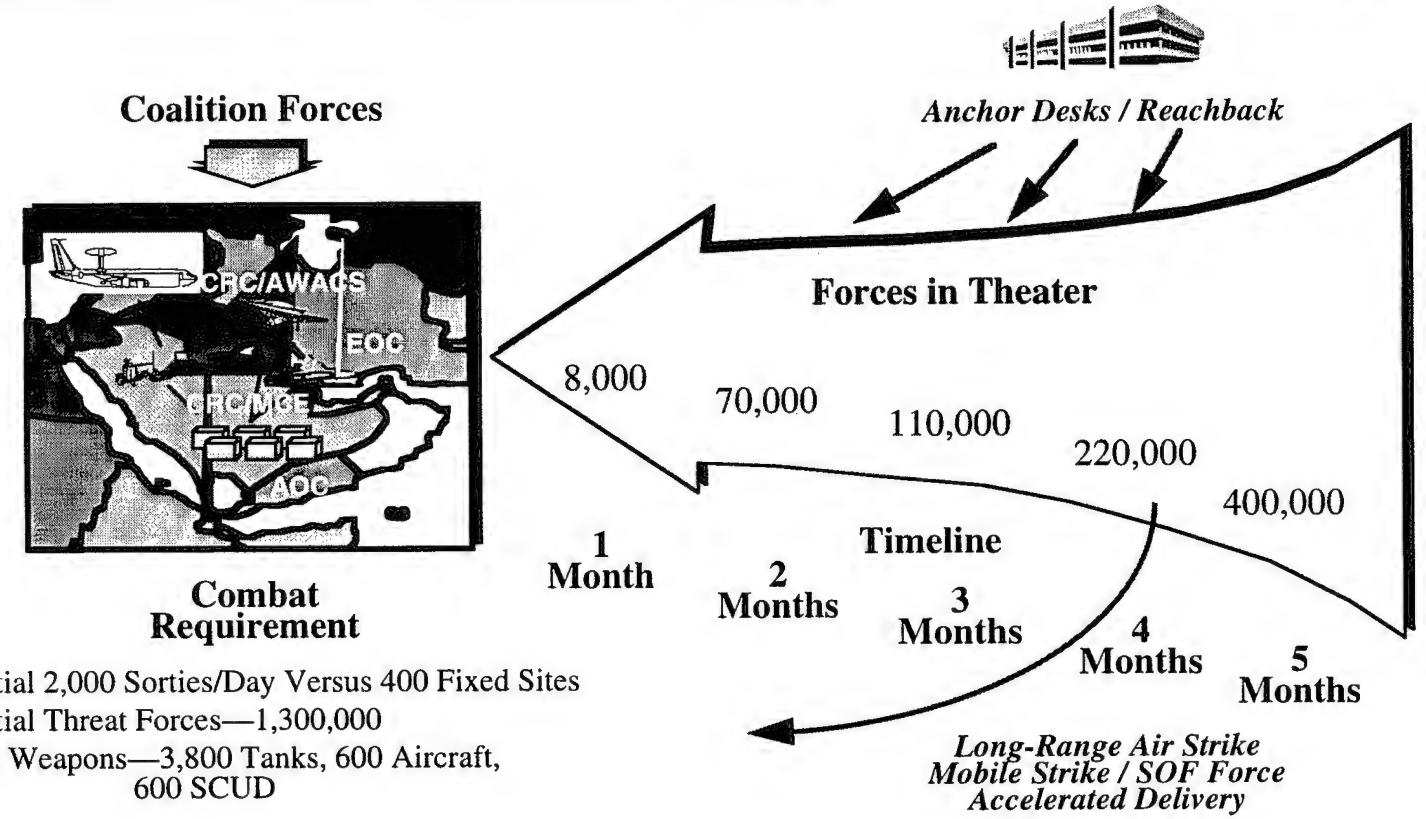
- Mission Rehearsal and Embedded Training
- Command Projection
- Support Simultaneous Engagement and Coordinated Operations
  - OTH
  - Force Allocation
  - Forcewide Hard/Soft Target Engagement Coordination
- Dynamic Tasking Tied to Central Strategy Throughout the Joint Force
- Repair and Consumables Management
- Joint Force Automated ROE
- Rapid, Accurate Targeting
  - Integrated Air Defense, Strike, and C2W
- Rapid, Accurate Battle Damage Assessment
- Force Status and Execution Following
  - Close Coordination, Detection, ID
- Shared, Dynamic Distributed, Continuous Collaborative Planning
- IW and Spectrum-Dominance Monitoring, Planning, and Execution

Needed Technology

- Continuous Dynamic Planning/Scheduling
- System-of-Systems, Optimization and Management
  - Distributed, Collaborative, Virtual Work Spaces
  - Sensor Information Fusion
  - Anchor Desks
    - > Nodal Analysis
    - > ATR, BDA
- Cognitive Support
  - Data and Uncertainty Visualization and Management
  - Speech and Text Understanding
- Rapid M&S, Including C3I

Incremental Force Projection

Goal:
Be Prepared To Fight From Any State of In-Theater Joint Force Projection, Using Flexible Combinations of Tailored Early-Entry Force Packages, Tactical Force Reconstitution, Global Reach, Accelerated Deployment, Virtual Deployment, and Reachback



Operational Concepts (Forces)

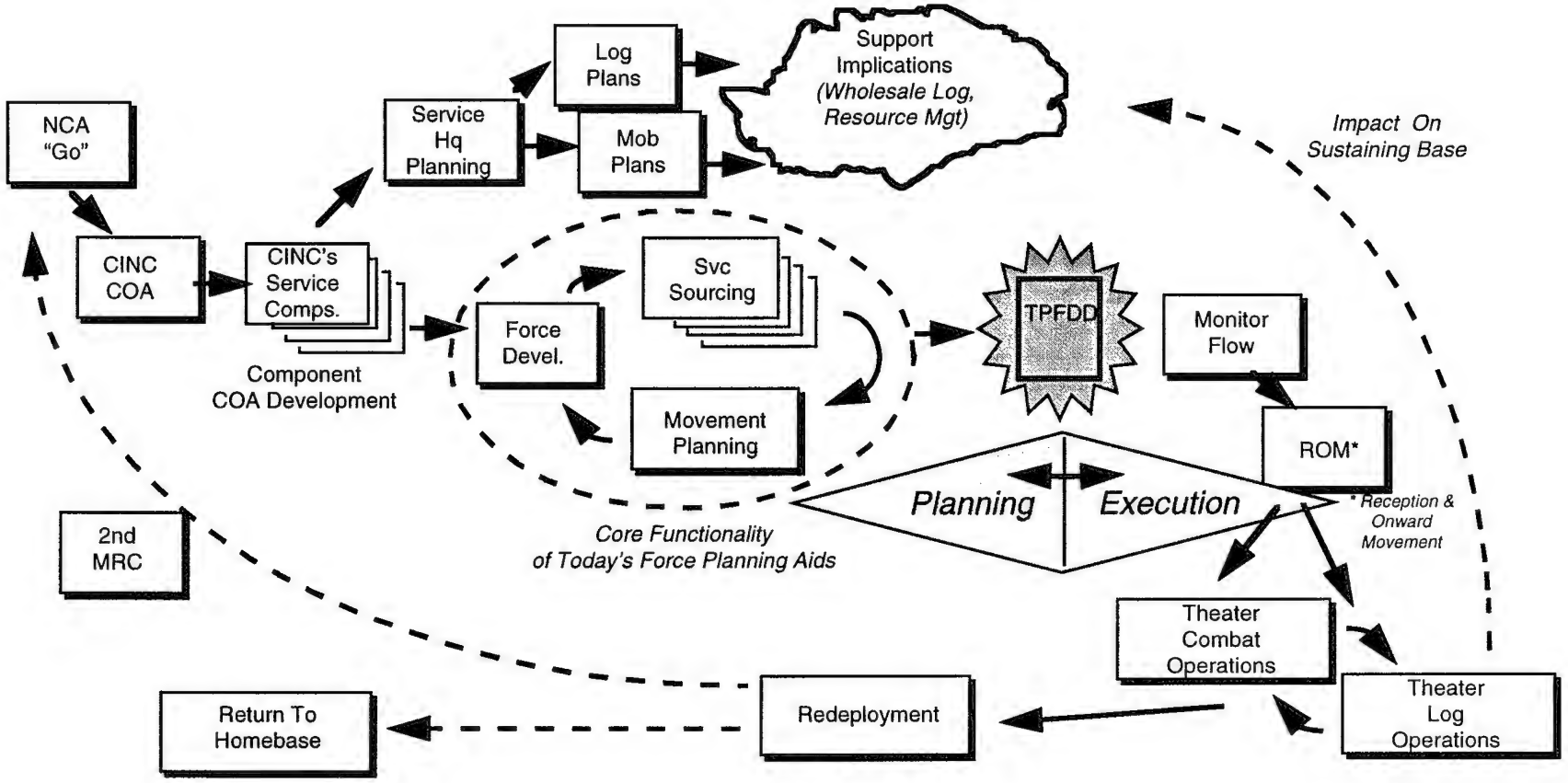
- Managing Windows of Combat and Support Opportunity
  - — Dynamic Force Package Tailoring and Reconstitution in the Field
    - » Mobile Strike Force, Early Entry Force, Rapid Force Projection
    - » Global Reach Strike, SOF, and Special Assets Missions
  - — Adaptive Force Package Tailoring and Redeployment of Global Reserves
- Total Asset and Requirements Visibility and Flow Control Dynamically Integrated Into Combat Planning Windows of Opportunity
- Splitbase Operations to Minimize On-scene Footprint
  - — Intelligence, METOC, MC&G, Logistics, Personnel, Finance, Maintenance, Special Operations Planning
  - — Rear Area May Be CONUS
  - — Use of Nondeployed Reserve Units
- Integrated Coalition Operations

C2I Operational Concepts

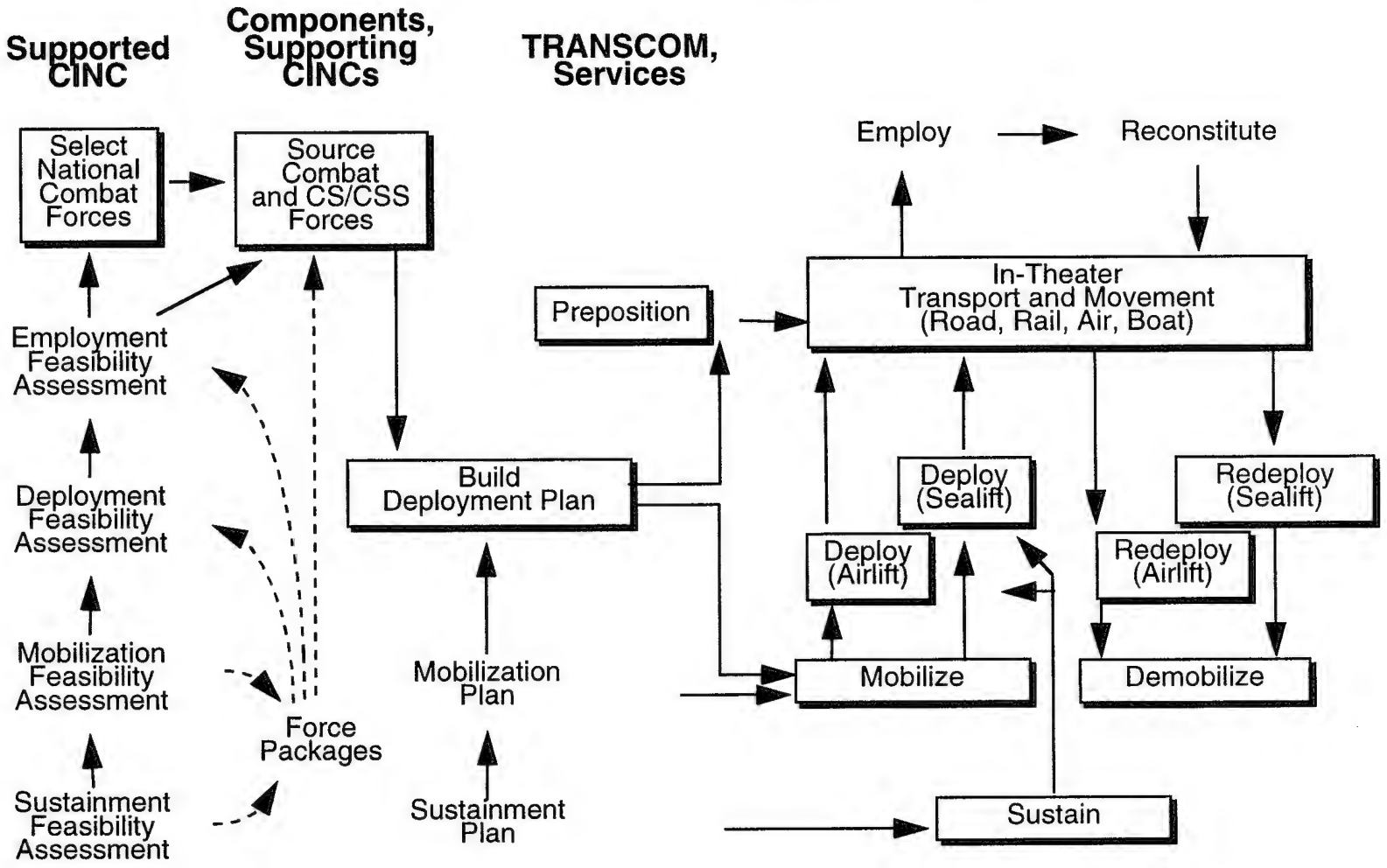
- High-Resolution Joint Force Package Tasking and Tracking Tailored to Mission at Hand
  - — Selection, Mobilization, Deployment, Sustainment
  - — Resolution to Mission, Unit, and Equipment Levels
  - — Conflict Resolution May Extend Upward to Joint Staff
  - — Dispersed, Cross-Functional Virtual Teams
- Dynamic Pipeline and Readiness Management
  - — Optimized Pipeline Reconfiguration and Scheduling
  - — Real-Time Flow Control Tailored to Attrition and Dynamic Consumption
  - — Offload Data Acquisition and Tracking Tasks From Humans
- Robust Planning and Assessment
  - — Concurrent, Interactive Operational and Logistics Courses of Action (COA) Assessment
  - — Cross-Echelon Mission Interaction, Collaboration, and Deconfliction
  - — Sensitivity to Changes and User Skills
  - — On-the-Move Replanning
  - — Plan and Train on Equipment and Technology Designated for Deployment in Garrison to Foxhole
- Coalition, Humanitarian, Early-Entry Force Options for Collaborative Planning and Execution

No-Plan Crisis Deployment—Current

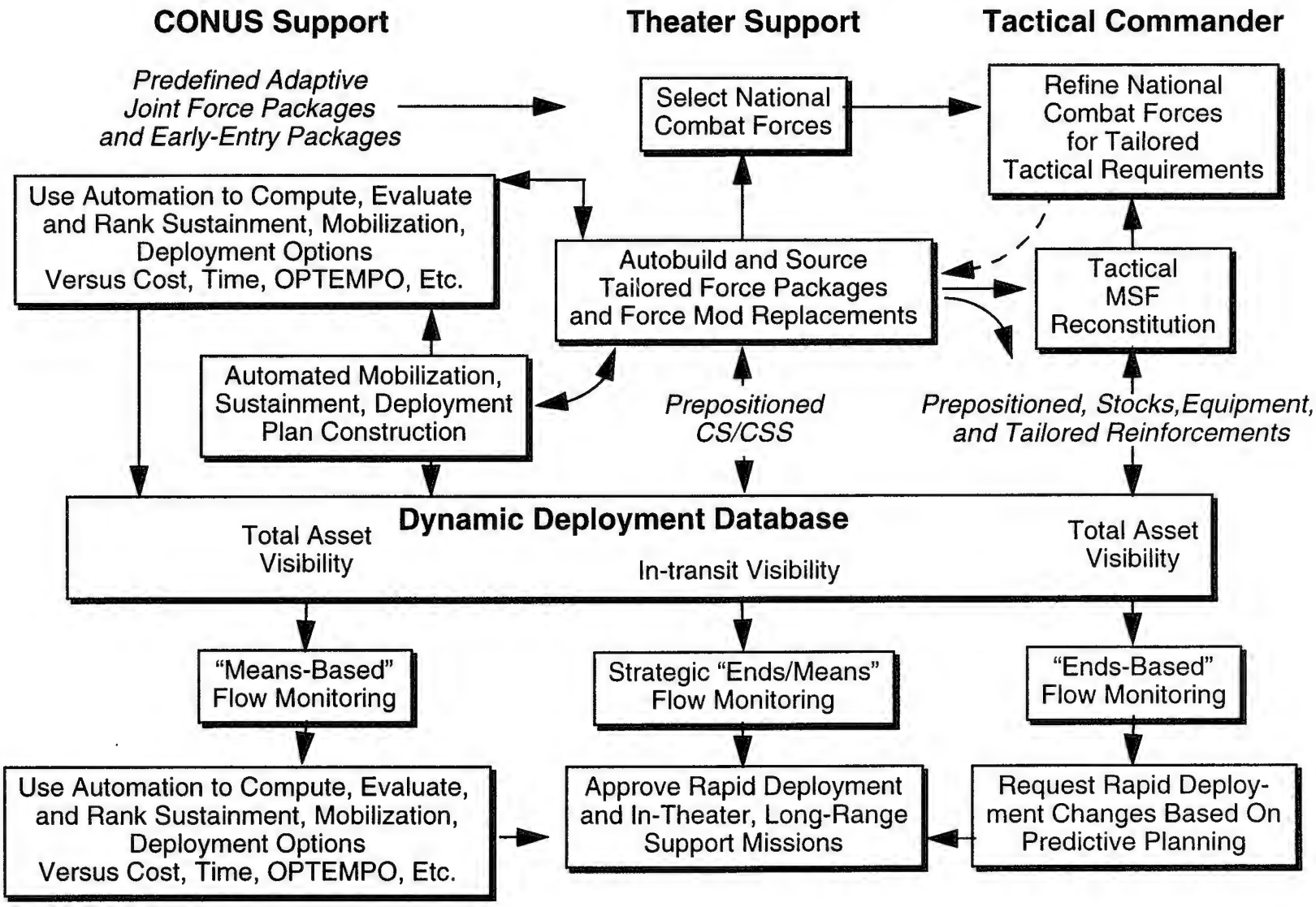
Today's "As-Is" Operations Planning and Execution Systems Enforce a Sequential Process That Inhibits Concurrent Planning, Unnecessarily Lengthens the Process, and Encourages Focus on the Means of Planning an Operation, Rather Than on the Ends of the Operation Itself.



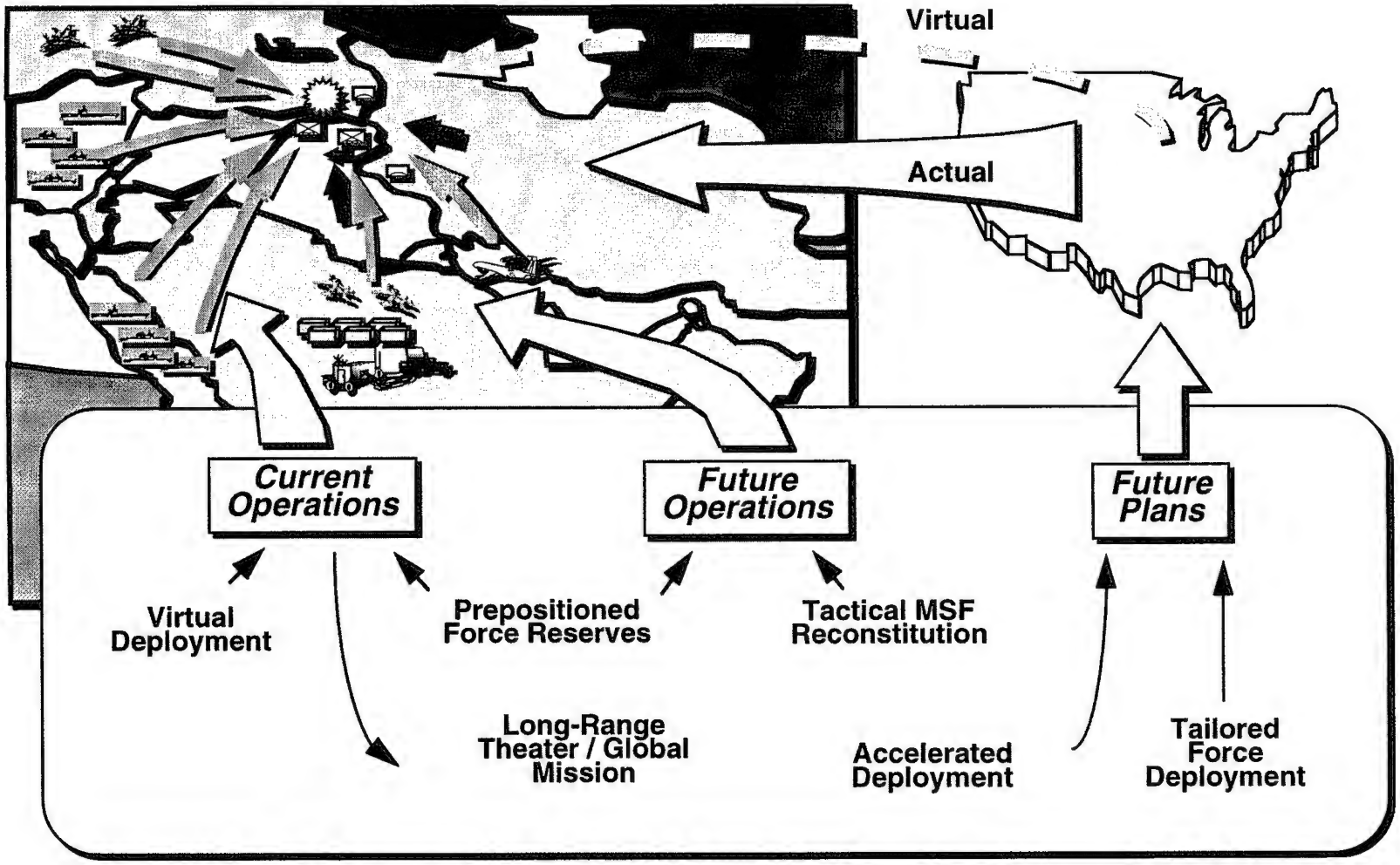
No-Plan Crisis Deployment—Current



No-Plan Crisis Deployment—Reengineered



Long Range, Just-in-Time Force Employment—Reengineered

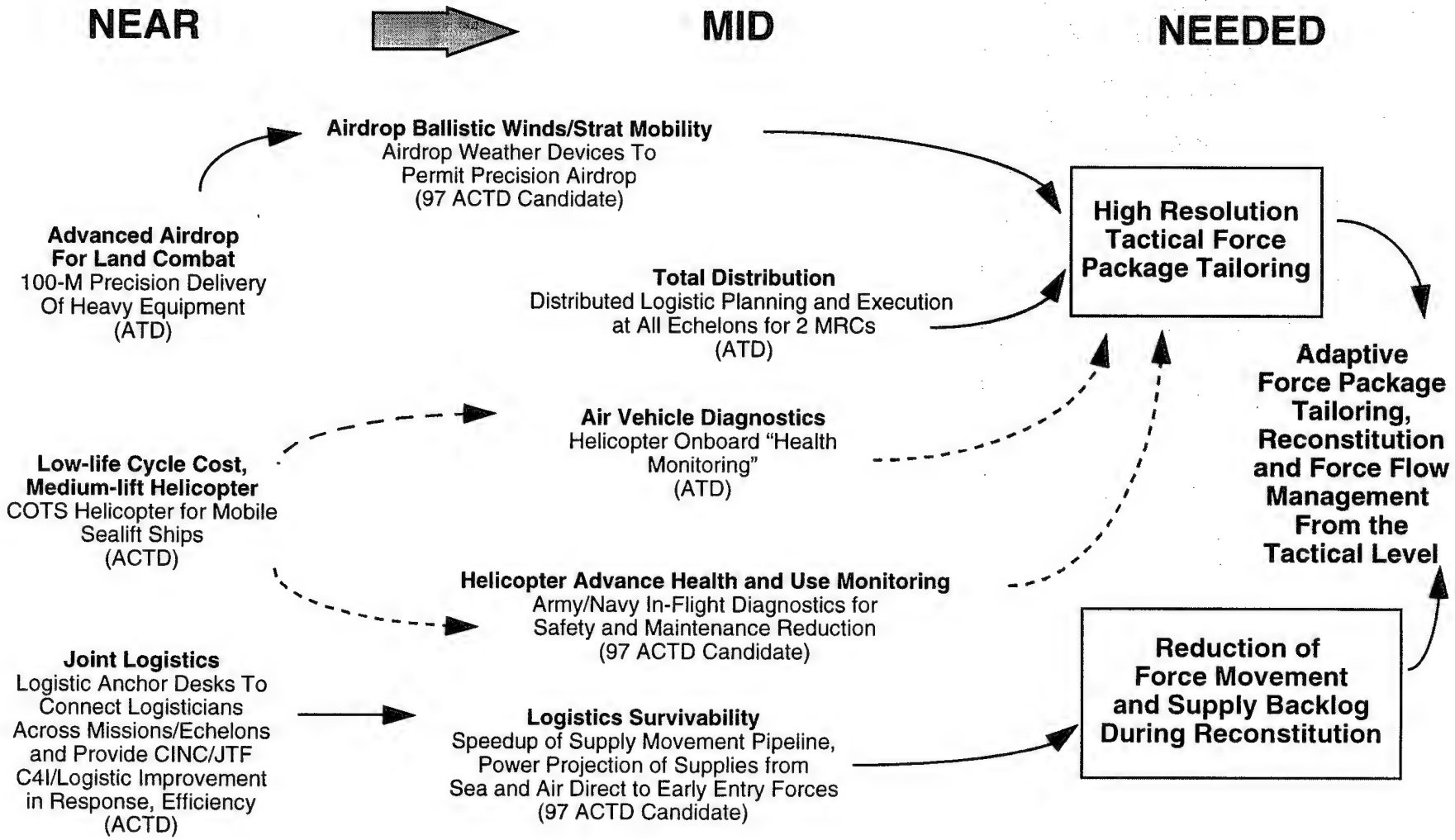


Current Limitations	Causes	Detailed Critical Functional Capabilities	Technology Challenges
Full-Up Planning Requires Large, Vulnerable Footprint in Theater	Comms Limitations and Cultural Precedent	Dispersed Cross-Functional Virtual Teams	Elevate Efficiency and Responsiveness of Anchor Desks to Tactical Support
Inadequate Support To Plan and Conduct Decisive Operations Using Tailored Forces Before to Full In-Theater Deployment of Forces	Cultural and System Support Problem in Conceiving How to Match up Force Packages and Their Logistic Tail at Right Time and Place	High Resolution Tactical Joint Force Package Tailoring, Tasking and Tracking – Forces "On-the-Way" – Forces "Within Reach" – Tactical Reconstitution	Near Real-Time Visibility of Assets and Forces at High Resolution While Maintaining Ability to "Reason" on Mission Capabilities of Packages
Planning Not Responsive to Changes in Numbers of Personnel, Skill Levels, and Transitions in Planners During Early Entry	Specialization in Training and Individual Experience That Creates Dependence on Access to Entire Organization	Robust Planning/Assessment Cross-Echelon, Cross- – Mission Operations And – Logistic Collaboration And – Deconfliction – User Skill Sensitivity – On-the-Move Replanning	Distributed, Variable-Fidelity Simulation To Enable Force Mission and Support Tailoring at Varying Levels of Aggregation
	Planning Tools Tend to Focus on Means Rather Than "Ends"	Plan and Train on Equipment Deployed With; Tactical Focus on Ends-Based Planning	Embedded Training With Distributed, Intelligent Agents To Translate Ends to Means
Planning With Coalition and Humanitarian Forces and Agencies Is Limited in Automation, Security, and Frames of Reference for Planning	Coordination and Scheduling of Coalition Assets Only Loosely Coordinated	Coalition, Humanitarian, Low-Data Rate, Early-Entry Options for Collaborative Planning and Execution	Low-Data Rate Collaboration Across Security Boundaries Using Automated Sanitization

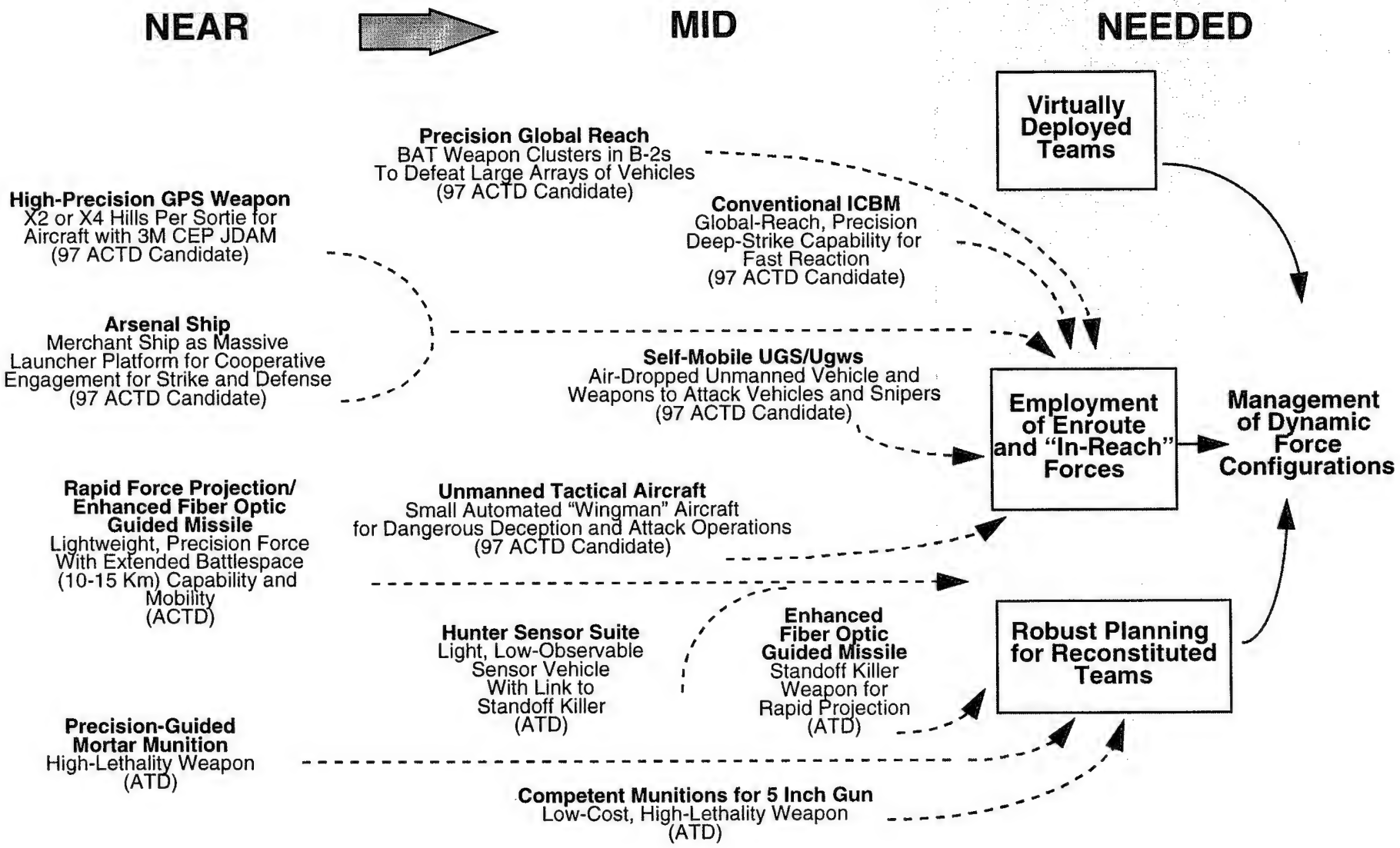
Detailed Critical Functional Capabilities Summary

- Dispersed Cross-Functional Virtual Teams
- High-Resolution Joint Force Package Tailoring, Tasking, and Tracking
- Robust Planning/Assessment
  - — Cross-Echelon, Cross-Mission Collaboration Deconfliction
  - — User Skill Sensitivity
  - — On-the-Move Replanning
- Plan/Train on Equipment Designated for Deployment
- Coalition, Humanitarian, Low-Data Rate, Early-Entry Options for Collaborative Planning and Execution

Current and Needed Operational Demonstrations



Current and Needed Operational Demonstrations *(Continued)*



Potential Metrics for Demonstration Areas

- **Management of Dynamic Force Configurations**
  - ***Real-Time, Continuous Access to and Between Cross-Functional Virtual Teams***
    - » Ability to Deploy Core Staff and Leave 75 Percent in Safe Enclaves
    - » Real-Time Tailored Support to Tactical Execution (Brigade and Below, Naval Unit) by Anchor Desks (Intelligence, METOC, Logistic, Personnel, Maintenence, Medical, Pol/Mil) in a Corps-Sized Force
    - » Compatibility of Collaboration With 10's of Coalition, SOF, Civilian Teams Using 2.4–56 Kbps Periodic Networks
  - ***Employment of Enroute and Within Reach Assets***
    - » Ability to Monitor Mission Capability and Availability and To Task Out-of-Area Shared Assets Within Organic Planning Cycle
- **Ability To Conduct Standoff Command From Airborne or Sea-Based Headquarters**

Potential Metrics for Demonstration Areas *(Continued)*

- **Management of Dynamic Force Configurations**
  - — ***Robust Planning and Assessment by Dynamically Changing Teams On-the-Move***
    - » Automated Deconfliction of Logistics To Enable Planner to Concentrate on Ends (Combat Forces, Missions) and Not Means (Support Forces, Logistics)
    - » Insensitivity to User Skill Level for 90 Percent of Planning Tasks
    - » Ability to Conduct End-to-End, Simulation-Based Training of Logistics Perturbations Using Actual Tactical C2 Planning Systems

- **Adaptive Force Package Tailoring, Reconstitution, and Force Flow Management From the Tactical Level**
  - — ***High Resolution Tactical Joint Force-Package Tailoring***
    - » Ability To Modify National Forces Database in <1 Hour
    - » Ability To Plan Major Force Reconstitution Based on Casualty Assessments and New Missions Within 15 Minutes
    - » Ability To Rearrange Support Logistics for Rapid Unit-Level Relocation Within 2 Hours
    - » Ability To Detach, Reassign, and Realign Support Tail for Brigade-Level Forces Within 3 Hours

Potential Metrics for Demonstration Areas *(Continued)*

- **Adaptive Force Package Tailoring, Reconstitution, and Force-Flow Management From the Tactical Level**
  - — ***Reduction of Force Movement and Supply Backlog During Dynamic Reconstitution, and Redeployment***
    - » Reduction in Total Lift Time To Redeploy for In-Theater Reconstitution, Lightweight Forces, and Increased Lethality (Less Munitions) and Survivability (High Mobility, Signature Reduction)—1 to 4 Days in Theater and 7 Days From CONUS
    - » A 50 Percent Reduction in Logistics Response Time From CONUS to Overseas
    - » Reduction in Total CONUS and Intermediate Support Base Backlog by 30 Percent Due to Tactical Reconstitution and Better Tracking of Mission Requirements and Flow
    - » A 10 Percent Reduction of Basing and Distribution Costs To Manage Flow of Units and Materials Arriving To Support Current Missions Without Backlogs or Shortfalls to Critical Operations
    - » A 50 Percent Reduction in Global Contingency Inventory and Storage

Incremental Force Projection

Goal

Lean Forward in the Planning Process To Avoid Direct Confrontation (by Employing Alternative Means); Be Prepared To React and Exploit Opportunities When Direct Confrontation Must Occur, and To Shape the Expected Actions To Stay Inside the Enemy's Decision Cycle and Keep Him Out of Ours.

Incremental Force Projection—Fight From Any State and Flexible Combination of Tailored Early Force Packages, Global Reach, Accelerated Deployment, Virtual Deployment, and Reachback

Current Limitations

- Automated Planning Systems Are Not Dynamic and Robust
- Wargaming Is Not Integrated in C2I and Cannot Be Used for On-line Planning Evaluation
- Sensor Tasking and Countermeasures Are Reactive to Emergent IW
- IW Is Not Integrated With Hard Kill as a Continuum of Tactical Options
- Failure to Exploit Frequency Spectrum as a Theater Weapon
- Lack of Distributed, Consistent Data at All Levels
- Fullup Planning Requires Large Vulnerable Footprint in Theater
- Inadequate Support for Operations Using Tailored Forces
- Planning With Coalition and Humanitarian Forces Is Inadequate

Critical New Functional Capabilities

- Collaborative Situation Assessment, BDA, ATR, and Planning
  - Precision Attrition Planning and Evaluation
- Situation and Command Projection
- IW and Spectrum Dominance Monitoring, Planning, and Execution
- Dynamic Tasking Tied to Central Strategy Throughout the Joint Force
- Repair and Consumables Management
- Shared, Dynamic, Distributed, Continuous Collaborative Planning
  - Rapidly Tailorable
  - Crises
  - Incremental Force-Projection Requirements
- Automated Mission-to-Target and Weapon-to-Target Pairing

Needed Technology

- Rapid C3I Modeling and Simulation
  - Spectrum Dominance and IW
  - Situation Projection
  - Red, Blue, White COA Assessments
  - Fault-Tolerant M&S for Mission, Rehearsal, Preview, Training
- Distributed, Collaborative, Continuous Dynamic Planning
  - Plug-and-Play Architecture
  - Automated Weapon Target Parings
- Virtual Anchor Desk Analysis
  - Heterogeneous Information Fusion
  - Automated Nodal Analysis

3. Conclusions

Key Opportunities for Battle Management in Planned Demonstrations

Battle Management Operational Concepts	Near Term 1997 - 2000	Mid/Long Term 2000 +
Consistent Battlespace Understanding	Distributed Situation Assessment Realtime Cognition Aiding Displays	Knowledge-based Information Presentation Cognitive Mission Support to the Warfighter
Predictive Planning & Preemption/Incremental Force Projection	Information Warfare Battle Management	Distributed Battlespace Opportunity Planning Theater Joint Information & Spectrum Dominance Adaptive Force Package Tailoring Management of Dynamic Force Configurations
Precision Information Direction	Integrated Sensor Tasking Multisensor Automatic Target Recognition Integrated Target Tracking	End-to-end, Task-synchronized, Mission Support Products to the Warfighter
Integrated Force Management/Adaptive Coordinated Defense	Joint C4I for Dynamic Force Projection	Distributed Empowerment Intelligent Joint Force Automated Cooperative Battle Doctrine/Rules of Engagement Retasking/Rehearsal for Coordinated Operations Enroute and On-the-move

Priority Technology Areas

Consistent Battlespace Understanding

- Cognitive Support and Decision Aids
  - Tactical Anchor Desks
  - Distributed Agents for Automated Plan and Spectrum Deconfliction
  - Dynamic Optimization of "Opportunity Planning" Within the Constraints of a Multidimensional Battlespace
  - Integrated Task, System, Terrain, Weather, Logistics, and Capabilities Reasoning Using Intelligent MC&G Representations
  - Advanced Human-Computer Interface
  - Uncertainty Management With Error-Tolerant and Deception-Tolerant Decision Support
  - Hard Kill/Soft Kill Decision Support
- Visualization
  - Projection, Quality Measures, and Uncertainty
  - Scaleability and Tailored Presentations
  - Intuitive Portrayal of Relative Advantages (e.g., Posture)
  - Rapidly Adaptive Interfaces Tailored to Mission Context
  - Virtual Reality and Multidimensional Data Visualization Applied to Complex Mission Interdependencies

Priority Technology Areas *(Continued)*

Consistent Battlespace Understanding (Continued)

- Automated Recognition, Entry, and Analysis of Information
  - Critical Node Analysis and BDA
  - Targeteering and Weaponeering
  - Seamless Interface to Heterogeneous Databases, Analyses, etc.
  - Automated Entry and Interpretation (Image, Text, Speaker-Independent Speech/Language Understanding)
  - Increased Attention to Large Scale Fusion (1000's of Sensors Fused in Minutes With Uncertainty/Error Handling and Multisource, Cooperative Tracking, Deceptive Threats)
  - Automated Pattern Recognition
  - Intelligent Inference To Extrapolate Known Behaviors and Defaults
  - Foreign Language Translation

Predictive Planning and Preemption

- Advanced C4I Modeling, Simulation, and Planning
  - Situation Projection
  - Rapid Model Generation With Changing Scenarios
  - Dynamic, Complex COA Evaluation, and Replanning Options
  - IW/C2W Countermeasures Effects/BDA; Multiplatform EMI
  - Predictive Counter-Moves and Countermeasures Effects
  - Continuous, Model-Based Assessment of Full-Spectrum of Battle Considerations (Logistics, Weather, etc.) Using Real-World, Incomplete Data
  - Tailorable Opposing Force and Deception
  - Variable Fidelity and Resolution, Validated Models for Progressive Refinement
  - Advanced Knowledge Representation

Priority Technology Areas *(Continued)*

Integrated Force Management/Precision Information Direction

- Dynamic Execution Management
  - Intelligent Agents for ISR Tasking Visibility, Deconfliction of Distributed Responses, Constraint-Based Plan Repair Options
  - Continuous, Dynamic Replanning and Rescheduling
  - High Performance Knowledge Bases for Dynamic Force Reconstitution Management
  - Intelligent, Cooperative, Distributed Battle Doctrine
  - Extension of Cooperative Defense to Mobility, Deception, etc
  - Doctrine/Constraints "Learning" by Autonomous Vehicles and Decision Aids
- System of Systems Performance Optimization
  - Easily Evolvable/Scaleable Architecture and Product
  - Realtime Diagnosis and Proactive Maintenance of Complex Distributed Systems; Fault-Tolerant Distributed Info Support

Consistent Battlespace Understanding

- Robust Collaboration and Dissemination of Understanding to Warfighter
  - Realtime Database Consistency, Dispersed Battle Management and Collaboration Using Heterogeneous Sources Including Broadcast and Low Data Rate
  - Common Representation for Battlespace Understanding (Situation, Plan, Execution Status, Distributed Mission Folders)
  - Enroute Understanding of Situation and Tasking Changes
  - Intelligent, Adaptive Compression
  - Distributed Software Libraries, Repositories, and Adaptively Prepositioned Products in Distributed Mass Storage

4. Glossary

ABCC	Airborne Command and Control
ABCCC	Airborne Command and Control Communications
ABIS	Advanced Battlespace Information System
ACTD	Advanced Concept Technology Demonstration
AD	Air Defense
AOC	Air Operations Center
AOR	Area of Responsibility
App	Application (usually refers to automated applications)
ARPA	Advanced Research Projects Agency
ATACMS	Army Tactical Missile System
ATD	Advanced Technology Demonstration
ATM	Asynchronous Transfer Mode
ATO	Air Tasking Order
ATR	Automated Target Recognition
AWACS	Airborne Warning and Control System
B-ISDN	Broadband Integrated Services Digital Network
BADD	Battlefield Awareness and Data Dissemination
BDA	Battle Damage Assessment
BM	Battle Management
bpp	Bits Per Pixel
C2	Command and Control
C2I	Command, Control, and Intelligence
C2W	Command and Control Warfare
C4I	Command, Control, Communications, Computers, and Intelligence
C4ISR	Command, Control, Communication, Computers, Intelligence, Surveillance, and Reconnaissance
CDC	Combat Direction Center
CEC	Cooperative Engagement Concept
CEOI	Communications and Electronics Operating Instruction

CINC	Commander-in-Chief
CJTF	Commanders, Joint Task Force
CMA	Collection Management Authority
CMW	Compartmented Mode Workstation
COA	Course(s) of Action
COE	Common Operating Environment
CONOPS	Concept of Operations
CONUS	Continental United States
CORBA	Common Object Request Broker Architecture
COTS	Commercial Off the Shelf
CP	Command Post
CVW	Collaborative Virtual Workspace
DBC	Digital Battlefield Communications
DBMS	Database Management System
DCE	Distributed Computing Environment
DDR&E	Director, Defense Research and Engineering
DISA	Defense Information Systems Agency
DMS	Defense Message System
DSP	Defense Support Program
DTAP	Defense Technology Area Plan
DTO	Defense Technology Objective
ECCM	Electronic Counter-Countermeasures
ECM	Electronic Countermeasures
ELINT	Electronic Intelligence
EMI	Electromagnetic Interference
EO	Electro-Optical
ESM	Electronic Support Measures
FLIR	Forward Looking Infrared

FST	Fire Support Team
FTX	Field Training Exercise
GBS	Global Broadcast System
GOTS	Government Off the Shelf
HAE UAV	High-Altitude Endurance Unmanned Aerial Vehicle
HCI	Human-Computer Interface
HTACC	Hardened Tactical Air Command Center
IAW	In Accordance With
ID	Identity or Identification
IFF	Identification, Friend or Foe
IMINT	Imagery Intelligence
Infosec	Information Security
IP	Internet Protocol
IPB	Intelligence Preparation of the Battlefield
IR	Infrared
ISAR	Inverse Synthetic Aperture Radar
ISDN	Integrated Services Digital Network
ISR	Intelligence, Surveillance, Reconnaissance
IT	Information Technology
ITO	Integrated Tasking Order
IW	Information Warfare
JBC	Joint Battle Center
JCPMS	Joint Communications Planning and Management System
JFACC	Joint Force Air Component Commander
JFC	Joint Forces Commander
JFLCC	Joint Force Land Component Commander
JFMCC	Joint Force Maritime Component Commander
JIC	Joint Intelligence Center
JIT	Just in Time

JPEG	Joint Photographic Experts Group (Standard)
JROC	Joint Requirements Overnight Council
JSTARS	Joint Surveillance and Target Acquisition Radar System
JTF	Joint Task Force
JWCA	Joint Warfighting Capability Assessment
KCOIC	Korean Command Operations/Intelligence Center
LRC	Lesser Regional Conflict
M&S	Modeling and Simulation
MASINT	Measurements and Signatures Intelligence
MC&G	Mapping, Cartography, and Geodesy
MILSATCOM	Military Satellite Communications
MLRS	Multiple Launch Rocket System
MLS	Multilevel Security
MMW	Millimeter Wave
MOE	Measure of Effectiveness
MRC	Major Regional Conflict
MRL	Multiple Rocket Launcher
MTI	Moving Target Indicator
NRT	Near Real-Time
NTM	National Technical Means
O&M	Operations and Maintenance
OIW	Operations/Intelligence Workstation
OPLAN	Operation Plan
OPSEC	Operations Security
OTAR	Over-the-Air Rekeying
OTH	Over the Horizon
PGM	Precision Guided Weapon
POM	Program Objective Memorandum
RDT&E	Research, Development, Test, and Engineering

REECE	Reconnaissance
RMA	Revolution in Military Affairs
ROE	Rules of Engagement
RT	Real-Time
S&T	Science and Technology
SA	Situational Awareness
SAR	Synthetic Aperture Radar
SAS	Survivable, Adaptable System
SATCOM	Satellite Communications
SIGINT	Signals Intelligence
SOF	Special Operations Force
SONET	Synchronous Optical Network
SSCN	Secure, Survivable Communications Network
STS	Sensor-to-Shooter
TAC	Tactical Air Controller
TAP	Technology Area Plan
TBM	Theater Ballistic Missile
TCP	Transaction Communications Protocol (used with IP)
TCT	Time-Critical Target
TEL	Transportable Erectable Launcher
TFCC	Task Force Command and Control
TLAM	Tomahawk Land Attack Missile
TOC	Tactical Operations Center
TOT	Time Over (or On) Target
UAV	Unmanned Aerial Vehicle
VCJCS	Vice Chairman Joint Chiefs of Staff
VTC	Video Teleconference

5. Working Group Membership

Co-Chairmen

Mr. Don Eddington	NCCOSC
COL Ron Fly	Joint Staff/J38

Participant	Organization
Dr. David Alberts	NDU
CDR Pat Allen	JCS/J38
MAJ Allred	HQAF/XOOC
Mr. Ed Ashley	SAIC
COL Del Atkinson	Rome Labs
LTC Edward Aymar	HPDA
Mr. Gary Barringer	Rome Labs
Richard F. Brown	Battle Lab
Mr. Sam Brown	JHU/APL
Mr. Hank Bush	Rome Labs
Mr. Brian Charnick	CECOM *
Mr. Dave Diamond	CECOM
Mr. Stu Draper	MITRE
COL John Eberle	SAIC
Mr. Don Eddington	NCCOSC
Mr. Gene Famolori	CECOM
CDR Jay Ferguson	OPNAV N62 *
COL Ron Fly	JS
Dr. Jude Franklin	PRC
Mr. Tom Garvey	ARPA
Mr. John Graniero	Rome Labs
CAPT Mike Hacunda	(DMA[AR])
Dr. Don Hanson	Rome Labs
Mr. Steve Head	USD (AT&T)
LTC Wes Hester	HQAF/XOXC
Maj Andrew Johnson	HQAF
Maj Allan Johnson	HQAF/XODC
Ms. Ann Jones	MITRE
Mr. Pat Jones	Joint Log, ACTDARL
Mr. Ken Jordan	SAIC

Participant	Organization
Mr. Mark Kaczmarek	PRC
Mr. Dave La Rochelle	ESC
LTC Fred Lindner	MCCDC
COL Robert L. A. Lossius	Battle Command Battle Lab
CAPT Jenny McGee	USAF
COL Martin Moakler	DFSP/DNA
LTC Ray Monroe	DIA/Cl-3
Mr. Dick Moore	PRC
CDR Chuck Norwood	SPAWAR
Mr. John Palerno	Rome Labs
LCDR Phil Pardue	JSC/J8
MAJ Dave Payne	Army AI Center
Mr. Frank Perry	DISA
Mr. Gary Pierson	NSA
MAJ Donna Powers	SAF/AQPC
Mr. Edward Prettyman	Johns Hopkins *
CAPT Joe Pridotkas	AF/INXX
Mr. Paul Quinn	ONR
Mr. Darrell Ramey	PRC
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MAJ John Rush	J2P
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LTC Richard Selapack	HQAF *
Ms. Rene Stevens	MITRE ADO *
Mr. Ray Urtz	Rome Labs
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LTC Doyle Weishar	ARPA ISO
CAPT Mike Winslow	OPNAV/N62
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* Subteam Leader